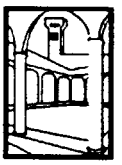
EUROPEAN UNIVERSITY INSTITUTE
Department of Economics

Essays on Policy Coordination

Luigi Bosco

Thesis submitted for assessment with a view to obtaining
the Degree of Doctor of the European University Institute

Florence, October 1995



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Introduction

We live in a highly integrated and strongly interdependent world. The development of market integration among national economies is matched by the higher degree of interdependence among national economies that has emerged dramatically in the recent years. What creates this interdependence is not only the integration of markets but also the presence of remarkable spill-over effects from one economy to others [1]. A special kind of interdependence is "policy interdependence", which arises when an economic policy decision in one country also affects a foreign country and vice-versa.

It is interesting, therefore, to analyse the new problems that such a high degree of interdependence poses for economists and policy-makers.

The first thing to note is that policy-making in an interdependent world becomes strategic, in the sense that when a country chooses its optimal policy, it must take into account how foreign countries will react. A country can no longer look at its policy-formation problem in isolation without considering what is happening in the rest of the world. From a theoretical point of view, it is evident that awareness of the strategic content of a policy in the modern world entails the use of the analytical tools of game theory.

The main question to answer is whether the decentralised process of purely national economic policy-formation is the best solution in an interdependent world. In other words, is there benefit to be drawn from coordinating national economic policies? In the last ten years, a good deal of research has been conducted in an attempt to answer this question.

Before proceeding, however, we should clarify the meaning of the closely related concepts of "coordination" and "cooperation", which are often used interchangeably in the literature. The taxonomy proposed by Horne and Masson (1988) can be effectively used for this purpose. They define policy coordination in a very narrow sense, imported from the game-theoretic literature, as the decision making that maximises joint

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1 By spill-over effect we mean, in the present context, the effect that a change in a macroeconomic variable (due to a change in policy, or to a shock etc.) of one country has on the macroeconomic variables of other countries. However, it should be pointed out that externalities other than macroeconomic spillovers also exist and can be quite important. An example is the pollution produced by the manufacturing sectors of one country, which affects the environment in another country.

welfare and thereby enables international interdependencies to be positively exploited. On the other hand, cooperation is defined in a broader sense to encompass all kinds of interchange between countries; interchange which can take different forms, including the exchange of information and opinions on economic affairs and agreement on the "rules of the game".[2] Moreover, it is worth noting that there are numerous possible uncoordinated policies according to the different hypotheses on the degree of cooperation that they embody. In a broader sense, we may say that the very first step of cooperation is acknowledgement and the awareness of the interdependencies between countries. It is generally thought that this first step of cooperation can be very rewarding in terms of welfare.

A higher degree of international coordination among the economic policies would seem the obvious response to the new problems posed by such a high degree of interdependence. The advantage of cooperation is clearly represented by the internalisation of the externalities of national policy making decisions. The debate on the desirability of this economic policy coordination is, however, still open on both theoretical and political grounds [3]. Rogoff's seminal paper (Rogoff, 1985) shows that the counter-intuitive result of the superiority of Nash policy over cooperative policy may occur when policy makers lack credibility. Rogoff maintains that since the coordination of monetary policies increases the incentive to renege on the announced policy, it exacerbates the credibility problem. Rogoff's point is quite straightforward. In the absence of coordination, reneging entails a surprise increase in monetary growth, which in turn leads to a depreciation of the currency: the associated inflation costs act as a disincentive to cheating. By contrast, under cooperation this disincentive disappears as the exchange rate is unaffected when both countries renege simultaneously. In this case the cooperative equilibrium seems to provide for a form of collusive behaviour between the national governments at the expense of the private sector.

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[2] The most popular and widely discussed "rule of the game"-based form of coordination is the target zone proposal (see Williamson and Miller, 1987). The suggestion is to assign domestic monetary policy to stabilizing exchange rates at their equilibrium level, able to ensure long-run current account equilibrium, domestic fiscal policy to control domestic nominal demand growth, and some combination of aggregate monetary and fiscal policy to stabilize global nominal demand. The proposal contains some elements of coordination (first of all the agreement on a consistent set of exchange rates, and the control of global nominal demand) but some aspects of policy may be left to the national Government to determine independently.

[3] Comprehensive surveys of the academic literature on international macroeconomic policy coordination may be found in Horne and Masson, 1988, Currie and Levine, 1991

Therefore, if policy makers were not able to make binding commitments to their *ex ante* optimal policy because of the absence of some institutional arrangements which effectively deter any change in the announced policy, the time inconsistent problem may render cooperation undesirable. In other words, it is thus evident that a correct comparison between cooperative and non-cooperative policy can be done only once a solution to the time consistent problem has been provided.

One can find in the literature different and quite distinct responses to the time inconsistent problem. One approach is to limit the analysis to only credible policies, i. e. policies which are constrained to the time consistent (see next chapter for details of the way in which these policies are obtained).

A mayor problem with this solution is that time consistent policies can be severely sub-optimal. Some alternatives were, therefore, proposed. Among them, the option most widely used in the literature on international economic policy coordination is to consider reputational equilibria in which the optimal policy, or more generally a policy superior to the time consistent policy, can be sustained by trigger mechanism [4]. There is a large literature which adopts this approach (Currie and Levine (1993) contains most of applications of this approach to international economic policy cooperation). This interest is also motivated by the consideration that a trigger mechanism can sustain also the cooperative agreements between the two governments. Trigger mechanisms may enforce efficient outcome when the cost of reneging, i. e. the *enforcement*, exceeds the gains from reneging, i. e. the *temptation*. Both enforcement and temptation depend on the punishment scheme and mainly on the length of the punishment period. Therefore the mayor shortcoming of the trigger strategy approach is that the choice of the punishment period is indeterminate and there is a multiplicity of efficient solutions which can be supported (Rogoff, 1987).

This is particularly serious for the private sector trigger mechanism when the game is between policy makers and the private sector and we assume that private agents are atomistic (Currie and Levine, 1993). In this case there is no prospect for a strategic choice of punishment period and it must be arbitrarily chosen. On the other hand, when

[4] Another option is to relax the assumption of complete information. In the present context, this means to relax the assumption that private sector has perfect information both of the true structure of the model and of policy maker preferences. Backus and Driffil, 1985, among the others, show that the uncertainty on the type of policy maker may sustain the ex ante optimal policy.

the game involves large players such as the two policy makers, it can be assumed that they choose the punishment period strategically. Therefore while the reputational approach can solve the problem of sustainability of cooperative policy among governments, it does not seem a sound way of solving the time consistent problem.

Because of the high degree of arbitrariness contained in the reputational approach, in the present work I limit the analysis to time consistent policy.

It is clear that when comparing time consistent policies, the result of the superiority of cooperation cannot be taken for granted. A cooperative solution will have a positive effect determined by the internalisation of policy externalities and a negative effect given by the worsening of the credibility problem. The net result will depend on the weights given to these two opposite effects. Other researchers have explored the dynamic aspects of policy coordination which were originally raised by Rogoff's example. Miller and Salmon (1985) and Levine and Currie (1987) give examples in which coordination reduces welfare because of time consistency problems. Kehoe (1989) and van der Ploeg (1988), moreover, show that this results could also arise in models with optimising microfoundations. Miller and Salmon (1990) and Miller Salmon and Sutherland (1991) show that the key factor in determining the merits of cooperation is the nature of the shocks affecting the economy. The more asymmetric the initial inflation displacements (the only kind of shocks considered by Miller and Salmon), or, in a stochastic environment, the less correlated the shocks, the less likely it is that coordination will pay.

In conclusion, when there are rational and forward looking private agents the desirability of a higher degree of international economic policy is far from being generally accepted.

Space and time constraints prevent me from following all the various strands of the international economic policy literature. Therefore, it is right and proper to stress all the points that are not to be covered in the thesis.

In what follows, we are going to analyse the international economic policy game; interdependencies, in our framework, will be characterised in terms of a three(four)-person game whose players consist of the two (three) policy makers and a homogeneous forward looking private sector. Therefore there are two different sets of bilateral (multilateral) relationships to consider. Firstly, there are those between governments and private sector. As we have seen, the outcome of the same announced policy may be different according to the hypothesis on the credibility of the policy makers; the lack of

credibility may affect the issue of the desirability of international economic policy cooperation. Secondly, there are the relationships between governments to consider: in this case too, a time consistent problem emerge since a policy maker may have the incentive to cheat on the other policy makers. This is the well known issue of the sustainability of a cooperative agreement.

Only the first issue will be addressed in the thesis. There are some important reasons that justify this choice besides the time and space constraint. The first is a logical one: the issue of the desirability of international economic policy cooperation comes first than the issue of the sustainability of an eventually reached agreement. Were the Rogoff's scepticism supported by our analysis, no need would be to analyse the topic of the sustainability of an undesirable and so unachievable cooperative agreement. In addition, as I already mentioned, the sustainability problem can be solved using some form of trigger mechanism; since the assumption of a strategic behaviour of policy makers is plainly acceptable, this approach does not raise the same doubts that it does in addressing the relationship between policy maker and atomistic private sector. Finally even without considering trigger strategies, one has to note that reneging on an international agreement is much more costly on political terms than a simple change in monetary policy [5]. This can be better understood if we realise that often the monetary table is just of the table on which the international political game is played. Along with it, a trade policy game can be played, for example.

As seen before, I concentrate on time consistent solutions of the policy game and do not follow that branch of the literature which, instead, suggests reputational mechanisms as a way of sustain *ex ante* optimal policy. A treatment of this approach can be found in Canzoneri and Henderson (1991) and Currie and Levine (1993). Neither I treat the more recent and interesting work on the interdependence between politically motivated - by a desire to be re-appointed or to implement a partisan policy platform - policy makers. In this case, the analysis of the international policy interactions is enriched by taking the incentive of the domestic policy process into account. An up-to-date survey of the literature is found in Persson and Tabellini (1995). Another interesting strand of the literature studies the effects of macroeconomic uncertainty on international

[5] This assumption is implicitly present in much of the literature which interprets the EMS as an instrument with which to apply inflationary discipline (see for example, Giavazzi and Pagano, 1988 these issues are also treated hereafter in chapter 4).

economic policy coordination. I do not treat these issues which are well summarised in a recent book by Gosh and Masson (1994).

Instead, the focus of the thesis is really on the issue of the desirability of economic cooperation when credible policies are considered. The aim of this thesis is to investigate more deeply the issue of desirability of international economic policy coordination in order to verify the robustness of the result that coordination may not pay. Is it as general as many of the researchers seem to argue? Does it depend on the model used to analyse the topic? A particular attention will be posed to the use of this apparatus in studying the economic cooperation in an European perspective.

The plan of the work is as follows.

The thesis is divided in two parts: the first analyses the theoretical issue of the existence of the benefits from coordination, the second part investigates more specifically the issue of the economic policy cooperation within Europe. The first part consists of three chapters; in the first of which critical analysis of the literature on policy coordination is conduced; in this section the main drawbacks to the traditional approach are identified.

In the second chapter, I take the Miller and Salmon model and investigate whether Rogoff's paradox is confirmed when some of the assumptions employed are relaxed or modified. This chapter provides some interesting evidence in confirmation of Rogoff's: coordination reduces welfare even when a conservative central banker is appointed, although cooperation in the first stage of the two stage delegation game is desirable; cooperation is counterproductive when policy instruments are costly, and when the exchange rate is taken as a policy target. Nevertheless, evidence more favourable to cooperation emerges as well: interestingly enough, when even a mild element of irrationality affects the foreign exchange markets cooperation response is clearly superior to Nash policy; furthermore when cooperative solution is defined as a result of a bargaining process, cooperation is again found to be desirable.

In the last chapter of the Part one, the Miller and Salmon model is abandoned and the issue of desirability of international policy coordination is reconsidered within a context of a two-country model with micro-foundations, intertemporal budget constraints, wealth effects and current-account dynamics. The result is rather favourable towards cooperation: it is shown that cooperation pays even in the case in which initial shocks are asymmetrically distributed and time consistent policies are considered. It is worth noting that the bias induced by the lack of credibility of policy makers appears

more substantial in the case of Nash policy than in the cooperative case, as testified also by the finding that gains from coordination are higher when time consistent policies are considered. Although a general rejection of the Rogoff paradox cannot be justified, a more careful attention should be posed to the analysis of cooperation using the time consistent policies in a context in which intertemporal budget constraints play an important role.

The second part of the thesis is dedicated to analysis of the issue within a context of European monetary integration. The principal focus of analysis is exchange rate targeting as a surrogate for more explicit forms of cooperation. This procedure has been proposed since it allows to save transaction costs, information costs and political difficulty with respect to full cooperation.

Two different lines of enquiry are followed: chapter four addresses the issue from an historical perspective, by analysing the EMS record in order to verify whether the European fixed rate arrangement worked well enough as a surrogate for a more complete form of cooperation and as viable route towards a monetary unification; chapter 5 instead approaches the issue theoretically using a three country version of the Miller and Salmon model proposed in chapter 2.

Part I. Benefits of policy coordination

1. Does any benefit accrue from coordinating national economic policies?

It is possible to distinguish different stages in the evolution of the literature on policy coordination. Analysis was initially conducted within a static framework. The policy-making problem in an interdependent world was described as a static game involving two players - the two policy-makers - in which the pay-off was represented by a social welfare function and the strategy sets consisted of the available economic policy measures. In this framework, it was easy to prove that a coordinated economic policy yields an outcome that is Pareto superior to that obtained by decentralized policy, although in some studies the empirically estimated gains from coordination were found to be negligible [7]. The policy implication of this result was quite straightforward: a higher degree of policy coordination was recommended. Subsequently, analysis was incorporated into a dynamic framework. The game now involved three players (two policy-makers and a private sector) since it was assumed that private agents have forward-looking expectations. It was shown that international policy coordination may in fact be counterproductive since coordination may exacerbate the time consistency problem created by the private sector's forward-looking expectations. The existence of cases in which cooperation does not pay clearly undermines trust in moving towards a higher degree of cooperation. More recently, this pessimistic result has been generalized, with the policy implication that policy coordinationn should not be the main issue on the political agenda but, rather, that more effort should be devoted to overcoming the time consistency problem.

The aim of this first chapter of the thesis is to conduct a critical analysis of the literature on policy coordination. The theoretical literature on this issue has grown rapidly in sophistication and complexity as well as in volume. My intention is not to provide a detailed and comprehensive review of all work produced. Instead I wish to extrapolate the core of the debate by identifying one of the most interesting questions

6 For a discussion of the Bonn Summit see Holtham (1988) and Putnam and Henning (1988).

7 In their pioneering study Oudiz and Sachs (1984) estimated that the gains from cooperation among G3 countries in the mid 1970s would be worth no more than 1/2 % of the GNP of each country, compared to the best non-cooperative outcome. Later studies have confirmed that the gains from coordination are likely to be small (Hughes Hallet (1986), Canzoneri and Minford (1986 and 1987). Other studies, however, have suggested that such gains improve considerably when either the exchange rate is considered a target of policy (Holtham and Hughes Hallet, 1987) or when "reputation" or persistent shocks are considered (Currie, Levine and Vidalis, 1987).

discussed by this literature: the social desirability of a higher degree of coordination [8]. At the end of the second millennium, decentralized policy-making process may be no longer able to handle the dramatic problems facing the entire world. Although the academic literature remains at a high level of abstraction, it can be used to evaluate the demand for a more centralized decision-making process at the international level.

1.2. International economic policy coordination

The pioneering work on the game theory approach to policy-making in an interdependent world was by Hamada (1974, 1976), who used a static analysis to study the strategic content of monetary policy in a system of fixed exchange rates. Oudiz and Sachs (1984) and Canzoneri and Gray (1985) have extended the analysis to a framework of flexible exchange rates. They show that competitive Nash behaviour yields an inefficient outcome since it fails to account for the externalities of economic policy decisions (spillover effects). A superior outcome can be obtained by setting a cooperative policy - through maximization of a weighted welfare function - that internalizes the economic policy externalities. The problem seems to be essentially the same as the standard problem of the "prisoner's dilemma" in textbook game theory. To the extent that it can be enforced, cooperative behaviour provides a superior outcome.

The literature on policy coordination within a static framework displays two major shortcomings. On the one hand, it considers the interplay between policy-makers in different countries without accounting for the interaction between the policy-maker and forward looking private agents. The game structure of the policy-making problem in an interdependent world is in effect a game with three, rather than two, players, even if the private sector does not behave strategically. On the other hand, it neglects the dynamic nature of the interdependence between national economies. To overcome these problems, the second generation of studies on policy coordination (see papers in Buiter and Marston (1985) and Bryant and Portes (1987) among others) has extended the analysis to consider dynamic strategic interactions.

As is widely acknowledged, several theoretical problems emerge when more complicated dynamic interactions are taken into account. As far as our topic here is concerned, for example, dynamic game theory must replace the simpler static game

8 Those interested in a complete overview of the policy coordination literature are advised to read Horne and Masson (1988), Currie, Holtham and Hughes Hallet (1988), Currie and Levine (1993) and Persson and Tabellini (1995).

approach.[9] Moreover, when the policy-maker considers more than one period in choosing his optimal policy in the presence of forward-looking expectations, the so-called "time inconsistency" or "dynamic inconsistency" problem arises (Kydland and Prescott, 1977). This means that a policy, optimally set at a given period, can become sub-optimal by the mere passing of time. This inconsistency may be recognized by rational economic agents, and thus policy will lose its credibility and private agents may be expected to react differently. In other words, the existence of an incentive to reoptimise in the future renders the policy non-credible in the present, and it will not be optimal even if adhered to. Barro and Gordon (1983) show that a lack of credibility leads to an inefficient outcome represented in their model by a rate of inflation different from zero. This issue is currently known in the literature as the "credibility problem" and it has brought a new perspective to the rules versus discretion debate (Barro 1987, Alesina 1988).

The time consistency problem has important implications for the issue of international policy coordination. In particular, it can be shown that international policy coordination may be counterproductive. In a famous paper, Rogoff (Rogoff, 1985) maintained that since the coordination of monetary policies increases the incentive to renege on the announced policy, it therefore exacerbates the credibility problem. Rogoff's point is quite straightforward. In the absence of coordination, reneging implies a surprise increase in monetary growth, which in turn leads to a depreciation of the currency: the associated inflation costs act as a disincentive to cheating. On the contrary, under cooperation this disincentive disappears, since the exchange rate is unaffected when both countries renege simultaneously. In this case the cooperative equilibrium seems to provide a form of collusive behaviour between the national governments at the expense of the private sector. Rogoff's major contribution was to stress that the cooperative solution of the policy-making problem in an interdependent world has costs in terms of higher credibility that must be taken into account when evaluating the merits of cooperation.

In more general terms, the central question regarding the existence of gains from coordinating national economic policies must be considered empirically by trying to estimate the benefits (or costs) to be derived from the coordination of national policies, and on theoretical grounds by incorporating the credibility effect into a more complete model of strategic behaviour.

9 This explains why most of the authors use numerical simulations to solve their model.

1.3.When does cooperation pay?

As already poineted out my intention is not to orderly review all the literature om policy coordination, both because I am interested in a more specific topic, the welfare benefit of coordination, and because I prefer to present a simple model and to use it as a guide to the literature on policy coordination.

The model proposed by Miller and Salmon seems best to exemplify the main conclusions reached by the literature in this field. The main features of this model - an extension of the one country model developed by Buiter and Miller (1982) - are the presence of temporarily sticky goods prices and "demand" determined output that ensures the substantial non-neutrality of money in the short run. Note that the model describes two identical countries with symmetric economic structure.

The model can be summarized as follows:

1.3.1) $y = -\gamma r + \delta c + \eta y^*$ and $y^* = -\gamma r^* - \delta c + \eta y$

1.3.2) $i = \phi y + \sigma \dot{c} + \pi$ and $i^* = \phi y^* - \sigma \dot{c} + \pi^*$

1.3.3) $\pi = \xi \phi z + \xi \sigma c$ and $\pi^* = \xi \phi z^* - \xi \sigma c$

1.3.4) $\dot{z} = y$ and $\dot{z}^* = y^*$

1.3.5) $E(\dot{c}) = r - r^*$

Equation 1.3.1) displays the behaviour of output (y), defined as a deviation from the natural rate level, which depends on the interest rate (r), the level of competitiveness (c), and on foreign output. The inflationary process (i) is described in equation 1.3.2) by a Phillips curve augmented by a term representing backward looking core inflation (π) and movements in the real exchange rate, which is taken to be a forward-looking variable. Equation 1.3.3) in turn shows core inflation derived from the integration of the equation of core inflation motion: $\dot{\pi}=\xi(i-\pi)$[10]. Equation 1.3.4) states that the variable z is the measure of cumulated past excess of demand. Equation 1.3.5) is a standard arbitrage condition stating that the real exchange rate is a forward-looking integral of future expected real interest differentials.

The authors assume the following economic policy loss functions:

$$W = \int_t^{\infty} \left[\beta_1 \pi^2 + y^2\right] \quad \text{and} \quad W^* = \int_t^{\infty} \left[\beta_1 \pi^{*2} + y^{*2}\right]$$

10 For a discussion of different core inflation representation see Buiter and Miller (1985).

The real interest rate is assumed to be the policy instrument.[11]

Using this model I can begin to answer the above question on the merits of coordination. In particular I will show that the crucial factor in determining the desirability of cooperation is the degree of credibility of governments (Miller and Salmon, 1985 and 1990, Miller, Salmon and Sutherland, 1991 and Levine and Currie, 1987). If governments have sufficient credibility to commit themselves to the full optimal policy then coordination is beneficial. Otherwise, if governments lack credibility vis-à-vis their private sectors, international cooperation may be damaging.[12] Comparing time consistent policies, that is, sub-optimal but credible policies, Miller and Salmon find that a crucial role may be attributed to the degree of correlation between external shocks. When shocks are symmetric or highly correlated, coordination appears to be beneficial, otherwise when shocks are asymmetric or negatively correlated coordination appears to be damaging.

The way in which the optimal policy and the dynamics of the full system are derived, is quite straightforward. The first order conditions of the Hamiltonian, along with dynamic equations of the economy form the adjoint system whose solutions give the path of state and output variables (see appendix to this chapter). The state dimension of the system does not allow an analytical solution, and the route followed by the authors and by myself has been to simulate the system numerically. The policy problem envisaged is inherited inflation pressure represented by a high initial value of z, that is, previous cumulated excess demand.

Note first that in a model like the one above, given the relative weights attached to output and inflation costs, it pays to achieve a rapid response to the initial inflation situation. The less "lethargic" the policy response, the less cumulated welfare cost will be obtained. This arises because output is supposed to adjust frictionlessly to the new demand so there are no costs in imposing a "cold turkey" measure instead of a more gradualist policy.

1.3.1. Comparing optimal policies with precommitment

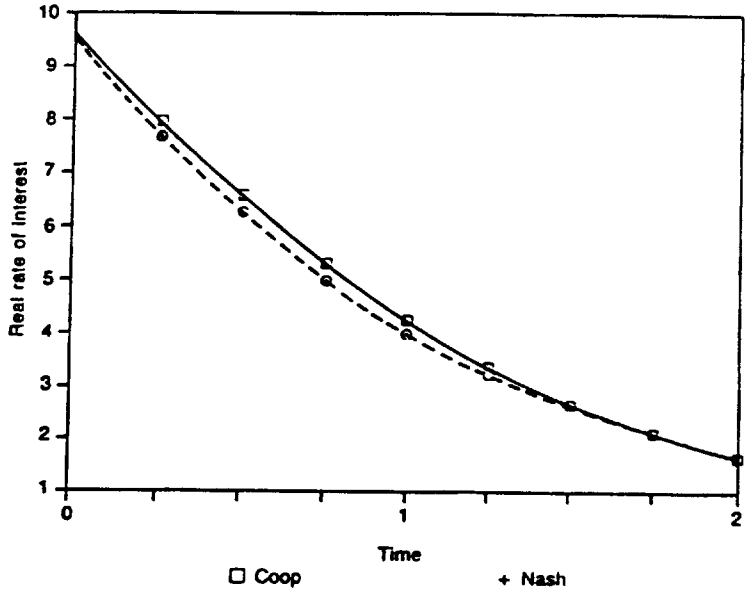
My main aim will be to compare the decentralized policy, that is a Nash policy, with the coordinated policy response to the initial shocks. Whereas in the Nash case the problem

11 It can be easily replaced by y.

12 It is worth noting that the following situation is proved to be true as well. Levine and Currie (1987) and Levine et al. (1987) show that in the absence of co-ordination, reputational (time consistent) policy may be undesirable.

for each country will be to minimize L (L^*) with respect to r (r^*), in the case of cooperative policy the objective, assuming the implicit existence of a central planner, will be to minimize a weighted sum of the two loss functions using both policy instruments. In this section I compare full optimal policy. In other words, I assume that for some reason, each government can credibly precommit itself not to cheat the private sector: the time consistency problem does not arise. The experiments are pursued using the same parameters values used by Miller and Salmon ($\beta_1 = \beta_2 = \phi = \xi = 1$, $\gamma = \delta = 1/2$, $\sigma = 0.1$ and $\eta = 1/3$) and the same initial displacement $z(0)=10$, $z^*(0)=0$.

Figure 1.3.1.



The differences between the two policies are evident from figure 1.3.1. Obviously, the cooperative reaction to the initial inflationary shock is faster than in the competitive case. The reason for this is straightforward: in the Nash case each government considers the positive effect on inflation obtained by the revaluation induced by the monetary contraction, so that it reduces its money supply - increases the real interest rate - less quickly than in the cooperative case. This positive effect disappears in equilibrium since both countries want to exploit it. Then the competitive reaction to the initial inflation shocks is more "lethargic" than the coordinated reaction. The advantage of cooperating is that it makes clear that no gains in terms of inflation can be obtained via a change in the real exchange rate and that a stronger monetary contraction is needed. A cooperative policy, in other words, averts the danger of a competitive revaluation.

In conclusion, we can say that when a government is able to precommit itself in order to make ex-ante optimal policy credible then cooperation will pay, in this highly simplified world. It is interesting to note, however, that from this result does not necessarily follow that the cooperative solution will be achievable; it can be in fact not incentive compatible for both countries. Table 1.3.1. shows the welfare costs at the national level distinguishing between output and inflation costs. While for the domestic country the cooperative solution assures less output and inflation losses, for the foreign country the opposite is true: therefore the latter has no incentive to enter a cooperative agreement with the other country. This result is easily explained by taking into account that, although we assume that the two countries are perfectly symmetric as far as economic structure and welfare preferences are concerned, they are hit by a dramatically asymmetric shock. Consequently a cooperative solution can be achieved only when a bargaining weight different from 0.5 is used in order to render the cooperative solution incentive compatible for both countries. This issue is extensively addressed in section 2.5.

Table 1.3.1

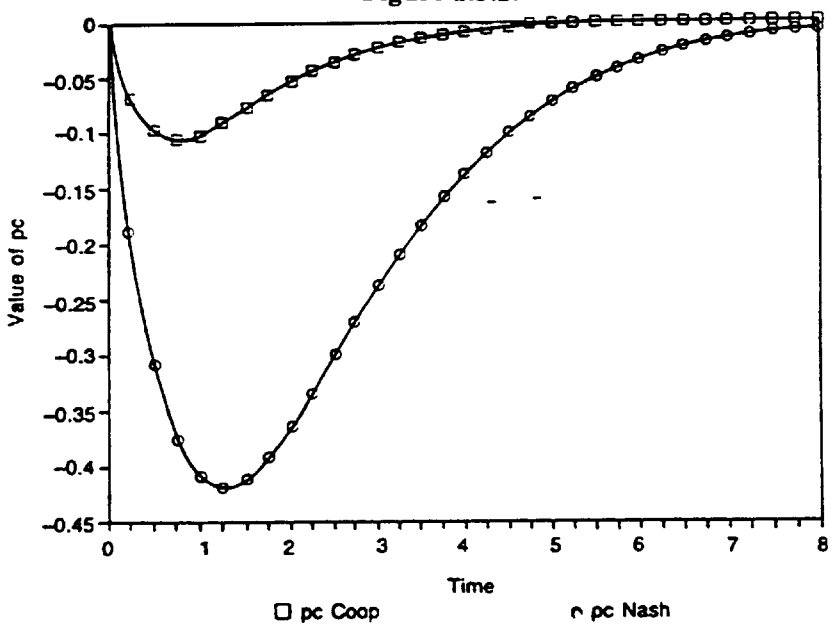
	Home country costs			Foreign country costs			World
	Output	Inflation	Total	Output	Inflation	Total	Average
Full optimal policy							
Nash	24.256	21.482	45.739	0.027	0.118	0.145	22.942
Coop	24.199	21.447	45.646	0.051	0.139	0.189	22.918
Time consistent policy							
Nash	23.223	22.591	45.814	0.023	0.113	0.136	22.975
Coop	22.941	22.942	45.882	0.085	0.085	0.170	23.026

1.3.2. Comparing time consistent policies.

In the absence of precommitment the optimal policy obtained by standard dynamic optimization is time inconsistent and thus not credible. This is evident from figure 1.3.2. which shows the behaviour of the shadow price of the real exchange rate, that is, the costate variable associated with the only non-predetermined variable in the model. After the initial period (t=0), when obviously p_c is zero, the shadow price of the real exchange rate turns negative, suggesting that an increase in the real exchange rate i.e. a decrease in our policy instrument r, will reduce welfare costs. As soon as the first period has passed,

the previously optimal policy will lose its "optimality" and will provide a strong incentive for reneging on the announced path of the policy instrument.

Figure 1.3.2.



It worth noticing that the behaviour of p_c differs according to the nature of solution: it is larger, in absolute terms, when a Nash policy is implemented. This means that the policy trade-off faced by a competitive policy-maker is more favourable. Since both policy-makers (Nash and cooperative) share the same welfare weights, the latter will force a more rapid exchange rate devaluation. This already suggests the main conclusion of this section. Rational agents will anticipate this behaviour and this will in turn bring about a higher inflation bias. The reasoning here is the mirror image of that proposed when the advantage of cooperation in a solution with precommitment was explained.

The last rows of table 1.3.1. show welfare losses in the case of a time consistent policy. Now the decentralised Nash policy yields a superior outcome with respect to the cooperative policy. An important result has to be stressed: the cooperative solution in this case produces higher welfare costs for both countries. Therefore, the welfare rank would not seem to depend on the weight assigned by the central planner to the national welfare functions [13]. This allows us to infer that the counterproductvity result depends on the

[13] In section 2.5. we will see that it is not completely true, since it affects the inflation bias.

increase in the inflation bias induced by the lack of credibility of the policy makers rather than on incentive incompatibility. This issue will be more deeply analysed in section 2.5.

What the time consistent policy consists of has still to be made clear. An early proposal for resolving the policy-making problem in the absence of precommitment is the "loss of leadership" solution (Buiter, 1986). The policy-maker is assumed to forgo any attempt to manipulate private sector expectations. This solution is equivalent to the policy-maker reoptimizing at each instant of time so that the marginal contribution of the non-predetermined state variable to welfare is equal to zero at every point of time. In our case, this means that p_c will be zero at every period. A major objection can be raised against this solution. Since the loss of leadership outcome implies continuous cheating, it also means that expectations are never fulfilled and they are therefore not rational; thus such an outcome cannot be credible. In other words, the solution proposed by Buiter represents a different solution concept, a return to an open-loop Nash solution where the policy-maker refuses to exercise its leadership with respect to the private sector. In other words, we may say that while this proposal eludes the problem by solving a different problem, it does not "resolve" it.

A more convincing solution is that proposed by Cohen and Michel (Cohen and Michel, 1988). Originally put forward to analyse time consistent solutions in Stackelberg leader-follower games, it has been used in many studies to find a time consistent solution for optimal government policy in models with rational expectations of future events (e.g. Oudiz and Sachs, 1985,, Miller and Salmon, 1985, 1989). The core of this procedure is to impose a new constraint on the policy-maker optimization problem - the non-predetermined variables must follow a path obtained as a linear combination of the state variables (in Miller and Salmon's model this constraint would be: $c = \theta_1 z + \theta_2 z^{*)}$ - and to drop the equation concerning the costate variable of the real exchange rate. The solution is obtained using dynamic programming, which avoids by construction any potential time consistency problem. The way in which the θs are computed is thus crucial; they are computed in accordance with Bellman's principle of optimality, ensuring that the solution will be time consistent and that private sector expectations are rational. Using this technique, it is possible to obtain time consistent solutions assuming either cooperative or competitive behaviour. It has been shown that an iterative procedure using the maximum principle (see Miller and Salmon, 1985 and Cohen Michel, 1988) can yield the appropriate θs. As a consequence of the iterative process the resulting path of the non-predetermined variable will be the same for the policy-makers and the private

sectors: it will be the result of the interplay between the need for the economic agents to forecast the value of non-predetermined variables, accounting for the incentive of the policy-maker to renege and the activity of policy-makers to maximise welfare taking this private behaviour into account. Cohen and Michel (1988) show that if we use a quadratic welfare function, the solution they derive is the unique sub-game perfect equilibrium [14].

From what has been said, it is clear that when comparing time consistent policies, the result of the superiority of cooperation cannot be taken for granted. A cooperative solution will have a positive effect determined by the internalization of the policy externalities and a negative effect given by the worsening of the credibility problem. The net result will depend on the weights given to these two opposite effects.

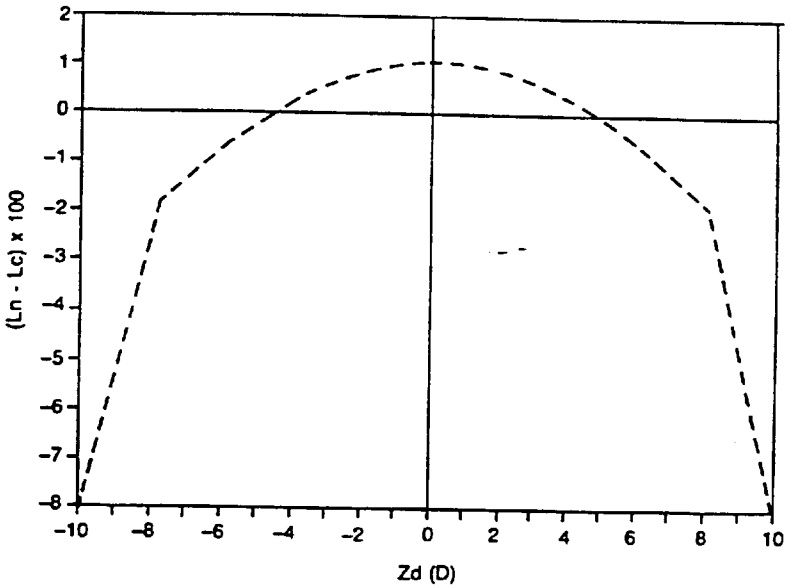
1.3.3. Coordination is likely to be counterproductive

Miller and Salmon in a paper (Miller and Salmon, 1989) considered what is in effect one such weighting system. They show that the key factor in determining the benefit of cooperation will be the nature of the shocks affecting the economy. The more asymmetric the initial inflation displacements (the only kind of shocks considered by Miller and Salmon), or, in a stochastic environment, the less correlated the shocks, the less likely is it that coordination will pay. The reason, shown by the authors with great elegance of analysis, can be grasped intuitively. An asymmetric initial inflation, in fact, increases the requirement of an optimal variation in exchange rate, which in turn enhances the credibility bias. When the initial inflation differential is high, or when the correlation between shocks is lower than a critical value, this negative effect will overcompensate the positive effect. Figure 1.3.3. shows the difference between non-cooperative and cooperative welfare losses for different values of initial inflation shocks. [15] In the central area, showing a situation where shocks are symmetric, cooperation appears to be paying, while in the tails, when shocks are asymmetric, decentralized policies are to be preferred.

[14] It should be stressed, however, that if we assume a more general form for the welfare function, we cannot have an unique solution. This is a well-known problem in classical game theory: the concept of perfect equilibrium does not necessarily yield a unique equilibrium solution (Rogoff, 1987) and there is as yet no reliable way of choosing among alternative perfect solutions.

15 I have used the same parameter values as the original Miller and Salmon model.

Figure 1.3.3.



The major merit of the paper by Miller and Salmon is that they have generalized the Rogoff result to show that, rather than being merely an intellectual curiosity the counterproductivity of coordination may be taken to be a general result. Gains from coordination can accrue, according to Miller and Salmon's argument, only in the case where symmetric countries face highly correlated shocks. Since such an occurrence appears to be rather unlikely, they reasonably conclude that the case in which coordination pays is rather unlikely too. This is quite important and in some sense conclusive: the results obtained by other authors (e.g. Oudiz and Sachs, 1985) are determined by the specific nature of the initial shock analysed [16]. The general result, Miller and Salmon argue, is that the net result of the two effects is that cooperation will not in general pay. Hence the policy implication that they draw is that the main effort must be devoted to ameliorating the credibility problem, rather than proposing experiments of cooperation.

1.3.4. Obstacles to international economic policy coordination

Obviously, there are potential obstacles to policy coordination other than credibility. Most of them relate to the bargaining process needed to define the coordinated policy. If

16 They analyse symmetric shocks.

we relax, in fact, the simplifying assumption of the existence of a central planner which implements the coordinated policy, the latter must be the result of some bargaining process. The bargaining process can be so costly as to discourage coordination (Feldestein, 1988). Moreover, coordinated policy must be sustainable in order to prevent governments from cheating each other. Levine and Currie (1987) show that, under some circumstances, a threat strategy can be implemented in order to sustain coordinated policy. In addition, there may be uncertainty over government objectives and preferences. In this context an incentive may emerge to misrepresent preferences. Hughes Hallet (1987) tries to estimate the gains accruing to the misleading countries and the losses paid by the misled countries using the MCM macro-model. He concludes that there is no incentive to misrepresent preferences and that, moreover, coordination reduces the dangers of such deceptions or specification errors.

Another source of error likely to reduce the incentive to, and the benefit from, coordination is model uncertainty. In order to cooperate, countries have to agree on the correct model to use for policy design. But there may be uncertainty about the features of the true model, and countries may also disagree about the model to use, or they may agree on a model when some other model is the correct one. The consequences of model uncertainty have been explored in some papers. The first (Frankel and Rockett, 1988), uses ten of the international models participating in the Brookings model comparison exercise (Bryant ed al., 1988), to show that when the two policy-makers subscribe to different models and the true model is a third one, the cooperative solution has the same probability of being superior as it has of being inferior to the Nash solution. This result seems to depend crucially on the assumption that policy-makers are *pigheaded* and do not explicitly account for divergences of model view. Frankel shows that the probability of welfare gains accruing from coordination increases when policy-makers use a compromise model in the case of disagreement (see Frankel, 1987).

More recently, Ghosh and Masson (1994) systematically reconsider the issue of international economic policy cooperation in a uncertain world. They find that uncertainty far form reducing the benefits from coordination, actually provides additional incentives to coordinate policies. If for example policy makers are assumed to update their beliefs about the correct structure of the world economy, then coordinated policies may again be superior to uncoordinated policies and to fixed rules even if the exact structural parameters of the model remains uncertain. It cannot be denied, however, that Gosh and Massson also stress the ironic result "that uncertainty, though making

coordination more desirable, probably makes it more difficult to achieve and to sustain" since "governments may attempts to misrepresent their beliefs over the effects of macro-economic policies during negotiation with a view to improving their bargaining position in a repeated game context.

Further considerations arise when the analysis is extented to a stochastic setting. Note first that the credibility problem, and the inefficiency involved in it, are less important in a stochastic environment. In the deterministic case, in effect, the incentive to renege derives from the fact that, at some point in the future, it pays the policy-maker to change policy in order to deal more favourably with the inherited state of the system. Whereas in the stochastic case the policy-maker must also consider the inferior performance that will be obtained with respect to future, currently unknown, disturbances as a consequence of reneging. Provided that the discount rate is not too high, the cost of this inferior performance can outweigh the gains in respect of past disturbances. In this case, the incentive to renege may disappear. Since rational agents realize this, the credibility problem may also disappear. Levine and Currie (1987), for example, show that even the full optimal policy may be credible and thus sustainable in a stochastic world, provided that the rate of discounting is not too high (see also Currie, Levine and Vidalis, 1988). It is interesting to note, however, that this result depends on the nature and on the length of the "punishment" or, in other words, on the structure of the reputational game involving economic agents and policy-makers. Since assumptions on this structure are, to some degree, arbitrary, the result cannot be taken as general.

There are different ways in which uncertainty can be introduced into these models. Tabellini (1988) applies uncertainty to the strictly political content of the game. He explores the case where a domestic political distortion induced by the uncertainty of the election outcome leads to an inefficient fiscal policy, biased toward budget deficit. The central result of his paper is that international policy coordination can exacerbate the deficit bias, reducing welfare at home and abroad and thus becoming socially undesirable. Lohmann (1993) examines the interaction between domestic policies and international co-operation. She finds that domestic politics matter for international relations: the intenity of domestical political competition affects the benefits and sustainability of international cooperation. Interesting insights on this issue can be found in Persson and Tabellini (1995)

1.3.5. Empirical estimates of the gains from coordination

Empirical studies which assess the potential gain from policy coordination have generally found the benefits to be significant but not large. In their pioneering study Oudiz and Sachs (1984) estimated that the gains from cooperation among G3 countries in the mid 1970s would be worth no more than 1/2 % of the GNP of each country, compared to the best non-cooperative outcome. Later studies have confirmed that the gains from coordination are likely to be small but somewhat larger (Hughes Hallet (1986a), Canzoneri and Minford (1986 and 1987). Other studies, however, have suggested that such gains improve considerably when either the exchange rate is considered a target of policy (Holtham and Hughes Hallet, 1987 and Hughes Hallet, 1987c) or when "reputation" or persistent shocks are considered (Currie, Levine and Vidalis, 1987).

Few authors have examined the likely distribution of cooperation gains among countries. Hughes Hallett's (1986b) study of the USA and EEC using a wide range of bargaining model suggests gains distributed 2:1 in favour of Europe. Hughes Hallett, Holtham and Hutson (1989) found a very asymmetric distribution of gains among G5 countries, when examining surrogate cooperation in form of agreed exchange rate paths.

The gains from coordination relative to non-coordination may well be smaller than those obtainable by taking explicitly into account the strategic content of policy making in an interdependent world. Canzoneri and Minford (1987) empirically investigate whether strategic behaviour really offers any advantage. They show that the move from "insular" behaviour, in which it is assumed that other players do not react to changing circumstances, to strategic behaviour interpreted as Nash non-cooperative equilibrium, indeed yields gains, and that they are larger than those obtainable by further moving from strategic Nash to cooperative behaviour. In addition Hughes Hallett (1987b) shows that the gains from information exchanges can hold even when the information exchanged contains prediction errors.

1.4. Can cooperation really be counterproductive?

As is the case of many results in economics, the Miller and Salmon assertion can be challenged on two different grounds. The first is its internal consistency, i.e. the logical coherence of the model, and the second its external consistency, i.e. the plausibility of the assumptions and simplifications used. Nowadays, while a great deal of weight is rightly given to the first requirement, unfortunately the second seems to be increasingly over-

looked. In my opinion this is rather misleading, especially when policy implications are to be drawn from theoretical analysis.

While the Miller and Salmon analysis is, in my view, fairly indisputable as far as its internal consistency is concerned, it is far less convincing when its external consistency is assessed. In support of this verdict, the reader is invited to compare the idealized world depicted by Miller and Salmon with their own idea of the real world. The latter is the world seeking an answer to the question of the desirability of a higher degree of cooperation, while the economy represented in the Miller and Salmon model appears too simplfied. In what remains of the present chapter I will discuss in more detail the shortcomings of the model employed by Miller and Salmon.

1.4.1. Limitations of the Miller and Salmon model

If we accept the Miller and Salmon conclusion, we must say that, generally, cooperation is not to be recommended to policy-makers. But how robust are these conclusions? Does their result depend on the particular model they used? In this section I try to answer these questions.

Three major weaknesses can be cited in the analysis carried out by Miller and Salmon; weaknesses which cast doubt on the robustness of the result of the counterproductivity of cooperation: the lack of any long-term policy trade-off, the simple way in which the exchange rate is modelled and the lack of any stock-flow interactions.

With regard to the first point, in this framework economic policy displays effects only in the short-term, while in the long-term every disturbance is efficiently absorbed. In very general terms, the quoted assumptions imply that there is no difference between the final equilibrium in the case of cooperative and non-cooperative solutions. Both in the cooperative and in the non-cooperative case, the long-run equilibrium of the output level is determined by the vertical long-run Phillips curve. Welfare comparisons must be based on evaluation of the different time paths of the target variables. In this context, international policy coordination is merely a disequilibrium problem, concerned with efficient adjustment towards given long-run values. [17]

As far as the third point is concerned, there is a marked contradiction between the characteristics of the model proposed and the features of the real-world economic situation. Important phenomena - such as the role played by the huge government deficits

17 However, results qualitatively similar to Rogoff's have been obtained in a model with genuine long run trade-off between inflation and output and with microfoundations (Van der Ploeg 1987).

and accumulations of public debt or the persistent current account disequilibria of some countries and their consequent accumulations of foreign debt - cannot be studied with such a simplified model. It is curious that, even though most of the political debate provoked by the G3 and G7 summits is concerned with the imbalances in current accounts and the threats to monetary stability arising from an excessively loose fiscal stance in the US and perhaps an excessively tight fiscal stance in Europe and Japan, the academic literature on international policy coordination almost entirely ignores the dynamic effects of current accounts and public sector deficits. It is hence vital to have reliable models which allow for wealth effects and intertemporal budget constraints for governments, private sector agents and the economy as whole.

Even more illuminating is the way in which Miller and Salmon and almost all other authors have modelled exchange rate behaviour. Uncovered interest parity is assumed to hold continuously. This means that the rate of change in the exchange rate is only determined by the interest rates differential. The use of this assumption - whose empirical evidence has been seriously questioned [18] - means that account cannot be taken of two of the main features of foreign exchange markets. This framework precludes any form of misalignment of exchange rates and any volatility of exchange rates greater than the volatility of fundamentals: in this case, interest rates. Nevertheless, even in this very simplified and highly unrealistic framework, a result of major importance has been obtained, although it appears to have passed unnoticed. When countries do not coordinate their economic policies, exchange rates fluctuate more than they do in the case of international cooperation. Miller and Salmon demonstrate that when there are asymmetric shocks and policy-makers coordinate their policies, the real exchange rate does not move as much as it does in the non- cooperative case. It is precisely this slower response of the exchange rate to shocks that drives greater welfare loss in the cooperative case.

This result hinges on two different assumptions which warrant attention. In the first place, the negative effect on welfare of a slower response by the real exchange rate crucially depends on the assumption that no positive weight is attached by policy-makers to exchange rate stability. The arguments for the welfare function are the deviation of output from its natural level and the inflation rate. Recent analyses seem to suggest, on the contrary, that a trade-off can be identified between the advantage of moving the exchange rate into an asymmetric framework and the cost of excessive exchange rate

18 See Mac Donald and Taylor (1992) among others. I will further disccuss this issue in sec 2.3.4.

variability. In a different context, Laskar (1986) has shown that exchange rate stabilization can be viewed as an intermediate public good. When no country is willing to engage independently in an exchange rate stabilization process, Laskar finds that exchange rates fluctuate more at the Nash equilibrium than they do at the cooperative equilibrium. Secondly, it should be added that the existence of a time-consistent problem in these models depends on the assumption that the exchange rate is a forward-looking variable, non-predetermined and therefore free to jump. However, jumps in exchange rates are rarely observed in the real world where monetary authorities (by their own will or perhaps because of international arrangements like EMS) often intervene to smooth exchange rates fluctuations.

1.5. Concluding remarks

The main aim of this introductory chapter has been to survey and evaluate part of the literature on policy coordination and to verify whether it is a convincing and satisfactory response by academic economists to the new problem posed by the high degree of economic interdependence.

The answer can be only partially positive. While the final lesson drawn from the papers surveyed here - that gains from coordination can be obtained only in special cases - has a strong policy implication, the assumptions employed in the analysis do not seem appropriate. By neglecting the key elements of recent policy debate on policy coordination (exchange rate volatility and misalignment, fiscal policy and public deficits, current account imbalances), the scope for policy coordination has been reduced ex-ante. It is not surprising that the cost of cooperation in terms of enhancing the time-inconsistency problem has been found to be greater than the benefit from coordination in terms of the internalization of the externalities of economic policies.

Our initial question concerning the efficiency of a decentralized process of policy-making in an integrated world is still unanswered. The aim of the next chapters will be to develop a less simplified model which can account for at least some of the features of the real world at the centre of the policy debate on international economic policy coordination.

1.A The adjoint systems

The Hamiltonian in the case of the cooperative policy is

$$H^C = \frac{1}{2}\left(\frac{\beta\pi^2 + y^2}{2}\right) + \frac{1}{2}\left(\frac{\beta\pi^{*2} + y^{*2}}{2}\right) + p_z\dot{z} + p_{z^*}\dot{z} + p_c\dot{c}$$

and in the case of Nash policy:

$$H = \frac{1}{2}\left(\beta\pi^2 + y^2\right) + p_z\dot{z} + p_{z^*}\dot{z}^* + p_c\dot{c}$$

$$H^* = \frac{1}{2}\left(\beta\pi^{*2} + y^{*2}\right) + p^*_z\,\dot{z} + p^*_{z^*}\,\dot{z}^* + p^*_c\,\dot{c}$$

The first order conditions of the Hamiltonian, along with dynamic equations of the economy form the adjoint system whose solutions give the path of state and output variables.

Full optimal policy

Open loop Nash

$$\begin{bmatrix} \dot{z} \\ \dot{z}^* \\ \dot{p}_c \\ \dot{p}^*_c \\ \dot{c} \\ \dot{p}_z \\ \dot{p}^*_z \end{bmatrix} = \begin{bmatrix} 0 & 0 & \frac{1-\eta^2}{\gamma} & 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & -\frac{1-\eta^2}{\gamma} & 0 & 0 & -1 \\ -\beta\xi^2\phi\beta\sigma & 0 & -\frac{\delta(1-\eta)}{\gamma} & 0 & -\beta\xi^2\sigma^2 & 0 & 0 \\ 0 & \beta\xi^2\phi\beta\sigma & 0 & -\frac{\delta(1-\eta)}{\gamma} & \beta\xi^2\sigma^2 & 0 & 0 \\ 0 & 0 & -\frac{(1+\eta)(1-\eta^2)}{\gamma^2} & -\frac{(1+\eta)(1-\eta^2)}{\gamma^2} & 2\frac{\delta}{\gamma} & \frac{1+\eta}{\gamma} & -\frac{1+\eta}{\gamma} \\ -\beta\xi\phi & 0 & 0 & 0 & -\beta\xi\sigma & 0 & 0 \\ 0 & -\beta\xi\phi & 0 & 0 & \beta\xi\sigma & 0 & 0 \end{bmatrix} \begin{bmatrix} z \\ z^* \\ p_c \\ p^*_c \\ c \\ p_z \\ p^*_z \end{bmatrix}$$

Cooperative Policy

$$\begin{bmatrix} \dot{z} \\ \dot{z}^* \\ \dot{p}_c \\ \dot{c} \\ \dot{P}_z \\ \dot{p}_{z^*} \end{bmatrix} = \begin{bmatrix} 0 & 0 & 2\frac{(1-\eta^2)(1+\eta)}{\gamma(1+\eta^2)} & 0 & -2 & 0 \\ 0 & 0 & -2\frac{(1-\eta^2)(1+\eta)}{\gamma(1+\eta^2)} & 0 & 0 & -2 \\ \beta^2\xi^2\phi\sigma & -\beta^2\xi^2\phi\sigma & 2\frac{\delta(1-\eta^2)}{\gamma(1+\eta^2)} & 0 & 2\frac{\delta}{1+\eta} & -2\frac{\delta}{1+\eta} \\ 0 & 0 & -4\frac{(1-\eta^2)(1+\eta)^2}{\gamma^2(1+\eta^2)} & -2\frac{\delta}{\gamma} & -\frac{2}{\gamma} & \frac{2\eta}{\gamma} \\ -\frac{\beta\sigma\phi\xi^2}{2} & 0 & 0 & -\frac{\beta\sigma^2\xi^2}{2} & 0 & 0 \\ 0 & \frac{\beta\sigma\phi\xi^2}{2} & 0 & \frac{\beta\sigma^2\xi^2}{2} & 0 & 0 \end{bmatrix} \begin{bmatrix} z \\ z^* \\ p_c \\ c \\ p_z \\ p_{z^*} \end{bmatrix}$$

Time Consistent Optimal policy

In order to obtain the time consistent solution, a further constraint has been added: $c= \theta(z-z^*)$ and the value of θ is obtained iteratively during the numerical simulation [19].

Cooperative policy

$$\begin{bmatrix} \dot{z} \\ \dot{z}^* \\ \dot{c} \\ \dot{p}_z \\ \dot{p}_{z^*} \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 & -2 & 0 \\ 0 & 0 & 0 & 0 & -2 \\ 0 & 0 & 2\frac{\delta}{\gamma} & 2\frac{1+\eta}{\gamma} & -2\frac{1+\eta}{\gamma} \\ g_1 & g_2 & 0 & 0 & 0 \\ g_2 & g_1 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} z \\ z^* \\ c \\ p_z \\ p_{z^*} \end{bmatrix}$$

where $g_1 = -\frac{\beta\xi^2}{2}\left[(\phi+\sigma\theta)^2+(\sigma\theta)^2\right]$ and $g_2 = \beta\xi^2\sigma\theta(\phi+\sigma\theta)$

[19] To simplify the presentation we have assumed that $\theta_1=-\theta_2$. Moreover this assumption is necessary in order to decompose this system in averages and differences.

Open loop Nash

$$\begin{bmatrix} \dot{z} \\ \dot{z}^* \\ \dot{c} \\ \dot{p}^N_z \\ \dot{p}^N_{z^*} \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 0 & -1 \\ 0 & 0 & 2\frac{\delta}{\gamma} & \frac{1+\eta}{\gamma} & -\frac{1+\eta}{\gamma} \\ f_1 & f_2 & 0 & 0 & 0 \\ f_2 & f_1 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} z \\ z^* \\ c \\ p^N_z \\ p^N_{z^*} \end{bmatrix}$$

where $f_1 = -\beta\xi^2(\phi + \sigma\theta)^2$ and $f_2 = \beta\xi^2(\phi + \sigma\theta)\sigma\theta$

Moreover in the case of the closed loop Nash equilibrium, the foreign authority acts as if: $r = \rho_{12}\, z + \rho_{22}\, z^*$ and domestic policy maker acts as if $r = \rho_{11}\, z + \rho_{12}\, z^*$. For a complete description of the way in which ρs are computed, see Miller and Salmon 1985, page 207-09.

By forming averages, that is $y_a = \left(\frac{y + y^*}{2}\right)$ and differences, $y_d = y - y^*$, the system, in the case of time consistent policy, can be decomposed into two separate blocks each involving but a single stable root.

Coordinated policy

$$\begin{bmatrix} \dot{z}_a \\ \dot{p}_a \end{bmatrix} = \begin{bmatrix} 0 & -2 \\ -\frac{\beta\theta^2\phi^2}{2} & 0 \end{bmatrix} \begin{bmatrix} z_a \\ p_a \end{bmatrix};$$

$$\begin{bmatrix} \dot{z}_d \\ \dot{c} \\ \dot{p}_d \end{bmatrix} = \begin{bmatrix} 0 & 0 & -2 \\ 0 & \frac{2\delta}{\gamma} & \frac{2(1+\eta)}{\gamma} \\ -\frac{\phi h^*}{2} & -\sigma h^* & 0 \end{bmatrix} \begin{bmatrix} z_d \\ c \\ p_d \end{bmatrix}$$

where $h^* = \beta\xi^2(\phi + \sigma\theta)$

Open loop Nash

$$\begin{bmatrix} \dot{z}_a \\ \dot{p}_a \end{bmatrix} = \begin{bmatrix} 0 & -1 \\ -\phi h & 0 \end{bmatrix} \begin{bmatrix} z_a \\ p_a \end{bmatrix};$$

$$\begin{bmatrix} \dot{z}_d \\ \dot{c} \\ \dot{p}_d \end{bmatrix} = \begin{bmatrix} 0 & 0 & -2 \\ 0 & \frac{2\delta}{\gamma} & \frac{(1+\eta)}{\gamma} \\ -\phi h & -2\sigma h & 0 \end{bmatrix} \begin{bmatrix} z_d \\ c \\ p_d \end{bmatrix}$$

2. Miller and Salmon's model: variations on theme

The previous chapter presented and discussed the model that Miller and Salmon (1985, 1989) and Miller, Salmon and Sutherland (1991) used to demonstrate the counter-productivity of cooperation. The present chapter verifies the robustness of their results by carrying out a of *sensitivity analysis* of the underlining model.

The first section addresses the issue of the preference structure. Two points deserve specific attention. The first concerns the relationship between the credibility bias and the preferences of the policy maker. In other words, it is interesting to verify whether the cost of cooperation can be reduced by assuming, following Rogoff (1985), that it takes place between countries which have elected conservative policy makers. If the policy maker has the incentive to delegate the monetary policy to an independent central bank, a delegation game arises together with the international economic policy game. The second issue regards the introduction of a certain degree of asymmetry in the model through asymmetry in the preference structure. Allowing for inter-country differences in policy preferences - more specifically in the coefficients for inflation in the welfare function, - the assumption is that one of the two countries attaches more weight to inflation than the other.

The second section relaxes the assumption that the implementation of the desired policy is a costless operation. It is of interest to verify whether the same qualitative result concerning the welfare ranking of Nash and cooperative policies can be confirmed once the existence of some cost on the use of policy instruments is taken into account.

Section 3 examines an important point: the role of exchange rate stabilisation in the analysis of policy coordination. From this point of view, the Miller and Salmon model appears rather unsatisfactory. On the one hand, it assumes that the foreign exchange market behaves properly and that the uncovered interest parity continuously holds; on the other, it denies the fact that one of the objectives of policy coordination is to stabilise exchange rates. In this section the Miller and Salmon's model is altered to take full account of the role played by the exchange rate. Analysed first is the merit of cooperation on the assumption that the stabilisation of the real exchange rate is one of the explicit targets of the policy maker. A mild form of irrationality is then introduced into the foreign exchange market.

Finally, a further crucial issue is analysed: the way in which Miller and Salmon compute the cooperative solution. There is no single solution concept for cooperative games that has the central role that the Nash equilibrium occupies in non cooperative games. As a consequence, specific attention should be paid to the choice of the solution concept to use. A sort of prerequisite for cooperation to be possible is that players should be able to discuss the situation and agree on a rational joint plan of action.

In order to summarise the directions in which I pursue the investigation, I report in table 2.1.1. the assumptions I employed to modify the Miller and Salmon model.

Table 2.1.1.

Assumptions	Does cooperation pay?	Remarks
Conservative policy maker: two stage delegation game	no	Cooperation in the first stage pays
Asymmetric preferences	no	
Instrument costs	no	Cooperation pays if instruments are considered intermediate targets
Exchange rate as target of policy	no	
Exchange rate market imperfection	yes	A fad has been introduced in the UIPC
Policy miopia: discount rate in the welfare function	no	
Nash Bargaining solution as cooperative solution	yes	The negotiation set may be empty

2.1. Benefit from cooperation and the preference structure

In this section I will concentrate on role played by the preference structure. In particular two issues appear of some interest: first of all, it is interesting to verify whether the traditional Rogoff's suggestion of solving the time consistency problem by appointing *conservative* policy maker can be of any help in reducing the counter-productivity of cooperation; secondly, it is interesting to verify the effects of assuming asymmetry in the preferences structure on the desirability of cooperation.

2.1.1. Policy coordination and delegation game

We saw above that international policy coordination should be evaluated by comparing costs of cooperation in terms of higher credibility bias and the advantage of cooperation in terms of the internalisation of policy externalities. On the other hand, the literature on

the credibility bias (Rogoff, 1985) suggests that the amount of the inefficiency caused by the impossibility of running credible anti-inflationary policies depends crucially on the preferences of the policy maker. The greater the weight on inflation in his loss function, the less incentive he has to run surprise inflation. This point becomes evident if one takes the extreme case in which the policy maker is only concerned with inflation: in this case the credibility bias, that is the costs determined by the lack of credibility of the full optimal policy, will disappear. This case has a straightforward economic interpretation: it is the case in which a *conservative* policy maker is appointed; that is, a policy maker whose anti-inflationary attitude is stronger than that of the median voter (β_m), (assumed to be the same in the two countries). In this framework, we can define the best *conservative* governor as the governor provided with the β - say β_g - that minimises welfare losses when evaluated by the median voter (that is, evaluated at $\beta_m=1$) . It goes without saying that this optimal β should be greater than that of the median voter in order to reduce the inflation costs, through the reduction of the inflationary bias, but not so high as to increase the output cost. The best *conservative* governor can be chosen either in a non-cooperatively or cooperatively by the two governments.

It is important to note that the nature of the policy game is now different and more complex. We have here a two-stage delegation game. In the first stage the national policy makers choose the governor's type, that is, its degree of *conservativeness*. In the second stage, the policy game takes place when the monetary policy is managed by the appointed governors. To play Nash in the first stage means choosing a governor whose preferences will maximise national welfare when assuming that the preferences of the other governor are given. It is interesting to stress that delegation arises because of monetary spillovers across countries in an international context, also in the absence of any inconsistency issue stemming from the lack of credibility of the monetary authorities (Dolado, Griffiths and Padilla, 1994). Both policy makers have the incentive to delegate the conduct of monetary policy to a more conservative governor when they expect the other policy maker not to do so. An inefficient outcome can obviously be the result of this symmetric behaviour because of the exchange rate externality. In this section the consequences of explicit consideration of the delegation game are analysed. In other words, it is of some interest to see whether the choice of a *conservative* governor improves welfare in the case in which an inflation stabilisation programme is pursued.

Accordingly I verify whether the appointment of a *conservative* central banker, rationally chosen to maximise welfare when evaluated by the median voter, may reduce

or even eliminate the inefficiency brought about by the lack of credibility and whether this will have any effect on the desirability of cooperation. Retaining the initial condition analysed by Miller and Salmon - $z(0)=10$ and $z^*(0)=0$ - I compare different scenarios.

Table 2.1.2

	Home country costs			Foreign country costs			World
	Output	Inflation	Total	Output	Inflation	Total	Average
Full Optimal policy	24.198	21.447	45.738	0.051	0.138	0.189	22.917
Coop - Nash	24.194	21.576	45.769	0.025	0.114	0.140	22.954
Nash - Nash	24.298	21.471	45.770	0.026	0.114	0.141	22.955
Coop - Coop	24.148	21.657	45.806	0.096	0.086	0.182	22.994
Nash time cons.	23.223	22.591	45.814	0.023	0.113	0.136	22.975

Table 2.1.2 shows welfare results of the different policies. The benchmark case (first row of the table) is that of the full optimal, but time inconsistent, policy which is obtainable only given pre-commitment. It obviously remains the best policy. When pre-commitment is not available, the anti-inflationary policy is not credible and private agents expect more inflation and less output deviation. The welfare results yielded by the time consistent solution is shown in the last row. The second and third rows give the welfare results when two *conservative* policy makers are appointed and then play a Nash game against each other. In the Coop-Nash case it is assumed that the central bankers are chosen in a cooperative way: their degrees of inflation aversion is such as to maximise the world aggregate outcome of the second stage Nash game (in this case the optimal value of β_g is equal to 1.09). The *cooperative* appointment of a conservative policy maker allows a marked reduction in the inefficiency caused by the lack of credibility and provides an outcome significantly closer to the full optimal policy. In the Nash-Nash case, on the contrary, it is assumed that the choice is decentralised: each country chooses a governor whose preferences will maximise the national welfare when assuming that the preferences of the other governor is given (the optimal value of β_g is 1.11). The comparison with the full optimal policy highlights that the central banker chosen is *over conservative*, and induces too high output costs. Nevertheless, also in this case delegation has proved to be fruitful. Moreover, in the delegation game with non-cooperation in the second stage, cooperation in the first stage leads to a less conservative banker than for a non cooperative choice and to a superior outcome. This result relies on the existence of a component in the delegation game which is not determined by the time inconsistency and credibility problems but by the existence of monetary spillover effects. The cooperative

choice of independent central bankers allows these effects to be internalized and thus yields a better result.

The Coop-Coop case, the welfare result of which is shown in the fourth row, shows that even when the cooperative time consistent policy takes place between, rationally chosen, *conservative* monetary authorities, the result of counterproductivity of cooperation is confirmed. However, when compared with cooperation between representative bankers, delegation appears desirable also when centralised policy making is assumed.

The results of this section can be summarized in the following welfare ranking:

a) cooperation in the first stage and Nash in the second stage, β_g=1.09, (W=22.954)

b) Nash in the first and second stage, β_g=1.11, (W=22.955);

c) competition between representative bankers, $\beta_g=\beta_m$=1, (W=22.977);

d) cooperation in the first and second stage β_g=1.115, (W=22.994);

e) cooperation between representative bankers $\beta_g=\beta_m$=1 (W=23.026).

2.1.2. Asymmetry in the preferences structure

Hitherto we have assumed that countries have the same preference structure: objective functions of the same quadratic form and equal relative weight attached to inflation. This assumption comes along with the perfect symmetry of the economic structure of the two countries. It is of obvious interest to verify whether the Miller and Salmon conclusions can be extended to the case in which countries are no longer symmetric. In this section, however, the assumption of symmetry in the economic structure is maintained while an asymmetry in the preference structure is introduced. In what follows I allow for inter-country differences in policy preferences - more specifically in the coefficients for inflation in the welfare function. I therefore assume that one of the two countries attaches more weight to the inflation cost than the other.

Table 2.1.3. compares these cases. The first two columns refer to the case in which the domestic country, that is, the country hit by the inflation shock, attaches much greater weight than the foreign country to inflation in the welfare function. The last two columns refer to the case in which the opposite pattern of inflation preferences is assumed; that is, the country more adverse to inflation is not hit by the inflation shock.

As was to be expected, the asymmetry in the preference structure brings about an asymmetry in the policy responses. Whereas in the benchmark case both the Riccati coefficients and the reaction coefficients display symmetric behaviour, in the asymmetric

cases both diverge. These values, on the other hand, display a similar but opposite form of asymmetry in the policy response and share the same dynamic structure, that is, the same eigenvalues. It is evident that the country with a greater weight attached to core inflation will show higher values for the reaction coefficients.

Table 2.1.3

	Asymmetric preferences $\beta_1=5, \beta_1^*=1$				Asymmetric preferences $\beta_1=1, \beta_1^*=5$			
	Closed-loop Nash		Co-operative		Closed-loop Nash		Co-operative	
Roots	-1.987	-0.925	-1.979	-0.903	-1.986	-0.925	-1.979	-0.903
Riccati coefficients:								
θ_1 θ_2	-1.307	0.789	-1.243	0.768	-0.789	-1.307	-0.768	1.243
Reaction coefficients:								
ρ_{11} ρ_{12}	2.628	0.415	2.564	0.464	0.988	0.072	0.980	0.253
ρ_{21} ρ_{22}	0.072	0.988	0.253	0.980	0.415	2.628	0.464	2.564
Initial values:								
z z*	10.00	0	10.000	0	10.000	0	10.000	0
y y*	-19.814	-0.427	-19.558	-1.565	-9.295	-1.224	-9.260	-1.565
π π^*	8.693	1.307	8.757	1.243	9.211	0.790	9.232	0.768
c	-13.067		-12.430		-7.891		-7.676	
r r*	26.278	0.724	25.644	2.534	9.883	4.148	9.801	4.638
Welfare costs:								
W W*	97.084	0.194			45.784	0.454		
Average	48.639		48.895		23.12		23.15	
gains from coordinat.	-0.52%				-0.13%			

Obviously, when considering initial shocks the results for the two asymmetric cases are quite different. In the first case the burden of the adjustment falls almost totally on the domestic country. This produces a sharp increase in domestic welfare costs, and a slight increase in the welfare costs of the foreign country with respect to the benchmark case. In the second case, by contrast, the asymmetry in preferences partially offsets the asymmetry in the shocks, and the domestic country shares some part of the adjustment costs with the foreign country. Since the foreign country policy maker is more adverse to inflation, he will use his policy instruments more actively than before: the reaction coefficient of the foreign country is higher than in the previous cases.

Figure 2.1.1 shows the behaviour of the domestic interest rate in the benchmark case, $\beta= \beta^*=1$, and when the domestic country has a stronger aversion to inflation, $\beta= 5$ and $\beta^*=1$. It is evident that in the second case the policy reaction is far sharper than in the benchmark case. More manifest is the change in policy reaction that takes places in the foreign country; figure 2.1.2 compares the behaviour of the foreign interest rate in the

benchmark case, when β= 5 and β^*=1 and in the opposite case in which β=1 and β^*=5. The highest policy reaction comes out when the foreign country displays a high anti-inflationry attitude, the lowest policy reaction arises when the domestic country displays stronger anti-inflationary preferences.

Figure 2.1.1

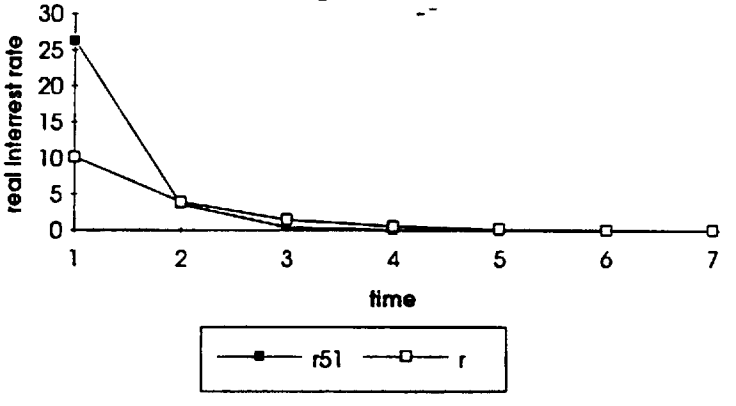
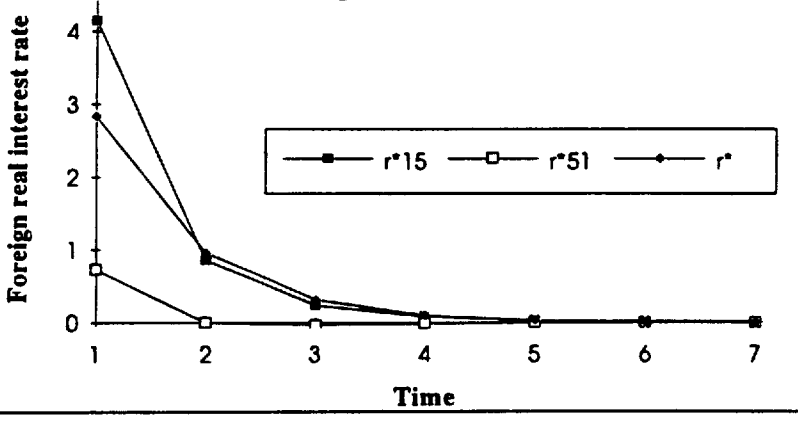


Figure 2.1.2.



As far as the benefits of cooperation are concerned, the ranking of the benchmark case does not change in the cases analyzed in this section. It is evident, however, that the ratio between cooperative and Nash welfare losses will move in different directions in the two cases as well as the total welfare costs. When the pattern of preferences reinforces the asymmetric response to the initial shocks (columns three and four), the relative gains from decentralized policy are higher than in the benchmark case, while in the other case these gains tend to be less than in the benchmark case. The latter result depends on two different phenomena. From a strategic point of view, the domestic country, which knows

that the foreign country will react relatively more than it does, has less incentive to implement a satisfactorily tight policy response and try to export some of the burden of adjustment (the reaction coefficient in the Nash case is less than it is in the symmetric case); and thus increases the cost of a decentralised policy compared with a coordinated one. In addition, since we are working with a quadratic welfare function, from a merely technical point of view total cost can be reduced by moving some of the cost from the country with higher cost (the domestic country hit by the initial shock) towards the country with lower cost. Since this cost reallocation takes place more noticeably in the case of cooperation, this explains why we have, in this case, a result more favourable to cooperation.

It is interesting to determine whether, in the case in which the same forms of asymmetries are assumed either in political preferences or in the economic structure, the Miller and Salmon result can be generalised in the presence of symmetric shocks. From a theoretical point of view, the presence of asymmetries in the political or economic structure renders it impossible to diagonalyze the original system in difference and average systems. Therefore the analytical approach used by Miller and Salmon can no longer be used, and we have to rely on the results from the numerical simulations. The results are similar to those obtained when asymmetric shocks and symmetric preferences were considered. When the preference structure is symmetric, coordinating the national economic policies pays off. The gains from coordination decrease when the asymmetric nature of preferences increases; when preferences are markedly different coordination is no longer beneficial. This result suggests that the Miller and Salmon conclusion can be extended to the case of asymmetric countries hit by symmetric shocks.

To conclude this section the Rogoff result can be generalised in the Miller and Salmon model: the cooperation of monetary policies increases the credibility bias and thus the inefficiency of the time consistent policy with respect to a decentralised policy. This negative result may be such to overcompensate the positive effect of cooperation when shocks are asymmetric and lead to the counter-productivity of international monetary policy coordination. This does not depend on the policy preferences of the policy maker i. e. on the value of the coefficient β. Even in the case in which two *conservative* policy makers decide to cooperate, the result of cooperation will be inferior with respect to the result of a decentralized policy, when shocks are asymetrically distributed to a sufficient extend.

2.2. Instrument costs

So far we have assumed that the implementation of desired policy is a cost-less operation. It may be of some interest to verify whether the same qualitative result concerning the welfare ranking of Nash and cooperative policies can be confirmed once the existence of some cost in the use of policy instruments is taken into account.

It is widely argued that instrument costs represent policy-making inertia and costs of policy implementation not directly captured by the model itself. A first rationale for introducing instrument costs is that there are implicit constraints on the extent to which some or each of the available instruments can be adjusted from their current or desired position. An indirect but simpler way to account for these constraints is to penalise the deviations of instruments from their current or desired value. A second rationale is to view instrument costs as an indirect means of incorporating uncertainty into the model. In the case in which the effect of the instruments on the targets is not known with certainty, for example, then a conservative policy maker will be reluctant to change the current setting of his instruments to the full extent that would be appropriate in a world of complete certainty. Obviously, both rationales are not completely satisfactory in the present context. In the first case monetary policy is generally acknowledged to be the most flexible, and hence the less costly to change policy instrument. As for the second rationale, this is evidently a very indirect way of accounting for uncertainty.

A different justification relies on the fact that in this model lacks explicit consideration of the capital market. Since the policy instrument is the real interest rate, the cost incurred by a change in the interest rate can be interpreted as a proxy for the capital account adjustment costs.

The welfare function is now:

$$W = \int_t^{\infty} \left[\beta\pi^2 + y^2 + \tau r^2 \right]$$

where τ indicates the weight that the policy maker assigns to the deviations of the instrument from their desired values (assumed to be zero).

From the foregoing argument it is quite clear what the main effect of this new formulation of the welfare function would be. Since the use of instruments is now costly, the optimal policy, both cooperative and non cooperative, will be less active and will involve a less rapid response to the initial inflation displacement. As already made clear,

given the characteristics of the Miller and Salmon model, more inertia in the policy reaction brings about higher welfare costs.

Table 2.2.1.

	Time inconsistent						Time consistent			
	Closed-loop Nash			Co-operative			Closed-loop Nash		Co-operative	
Roots	-0.620	-0.620	-0.533	-0.694	-0.694	-0.600	-0.588	0.469	-0.600	-0.480
Riccati coefficients:										
θ_1 θ_2 (θ_3)	-0.651	0.651	0.330	-0.637	0.637	1.344	-0.606	0.606	-0.516	0.516
Reaction coefficients:										
ρ_{11} ρ_{12} (ρ_{13})	0.461	0.147	-0.495	0.486	0.314	-1.168	0.491	0.134	0.524	0.276
ρ_{21} ρ_{22} (ρ_{23})	0.147	0.461	0.495	0.314	0.486	1.168	0.134	0.491	0.276	0.524
Initial values:										
z z*	10.000	0		10.000	0		10.000	0	10.000	0
y y*	-5.311	0.751		-5.711	0.287		-5.283	0.598	-5.400	-0.598
π π^*	9.349	0.651		9.363	0.637		9.394	0.606	9.484	0.516
c	-6.501			-6.372			-6.058		-0.517	
r r*	4.612	1.469		5.361	4.859		4.906	1.343	5.240	2.761
Welfare loss:										
W W*	65.065	2.142					67.293	2.130		
Average	33.604			33.342			34.712		35.106	
Gains from cooperation	0.785%						-1.135%			
Intermediate target loss							27.877		27.635	

Table 2.2.1. summarizes the main results when assuming that τ=1. Not surprisingly, in all cases welfare losses are higher than those reported in the standard Miller and Salmon case (in which $\tau = 0$). Two factors account for the increased welfare costs: the alleged slow-down in policy response and the new cost component itself represented by the deviation of the interest rate from its desired path. The value of the reaction coefficients reported in table 2.2.1. gives a measure of this slow-down. In order to isolate these two components, the second part of the table sets out the welfare costs in the case where the second component is neglected. The choice between these two different criteria evidently depends on which of the two alleged justifications for introducing instrument costs is preferable. If the first justification is assumed to dominate, the direct component must be considered, since this represents the cost that the policy-maker incurs in changing the policy instrument. In the second case, the policy instrument is not costly in itself; its cost is introduced in the welfare function as a *proxy* for something else, either the presence of uncertainty or not explicitly considered capital account costs, and can thus be regarded as an intermediate target.

As is evident from the table, the result of the counter-productivity of cooperation is re-confirmed when the minimisation of instrument costs is taken on to the welfare

function. The reason for this is the same as was postulated in the discussion of the original Miller and Salmon model. The credibility bias involved in the cooperative policy brings about a slower response of the policy instrument which slackens the return of the target variables to their equilibrium values. The presence of instrument costs in the welfare function seem to have exacerbated the inefficiency of the time consistent policy more severely in the cooperative case than in the Nash one [20]. Once private agents know that the policy-maker assigns a weight to the deviation of the interest rate, the announcement of a policy involving a strong reaction to the initial displacement would be less credible. This is more important in the case of a cooperative policy because the coordinator now has the instruments of both countries in the welfare function.

Table 2.2.2

	Home country costs			Foreign country costs			World
	Output	Inflation	Total	Output	Inflation	Total	Average
Closed loop Nash	13.123	42.341	55.465	0.085	0.754	0.839	28.152
Coop	13.419	41.641	55.059	0.083	0.128	0.211	27.635

Rather surprisingly, the welfare ranking is reversed when real interest is considered to be an intermediate target and the value of τ is sufficiently high [21]. Table 2.2.2. reports the inflation and output costs. Welfare costs are generally still higher than in standard case because of greater policy inertia. However, it is evident that most of the augmented cost can be ascribed to the instrument cost itself. I have already explained that the benefit from cooperation can be evaluated by comparing the average response and the differential response with the initial inflation displacement. The cooperative response is better in terms of average response - because it internalises the external effect - but it is worse in terms of difference response because of the lack of credibility. The balance between these two effects will depend on the asymmetric nature of the shocks. In the present case, a cooperative policy is still worse in terms of difference, but it is much better in terms of average response, and in this case the balance is in favour of cooperation [22]. This

20 Whereas in the standard Miller and Salmon case ($\tau = 0$) the increase in welfare costs deriving from a lack of pre-commitment can be evaluated at the 0.15% for the Nash and at the 0.47% for the co-operative case, in the case in which $\tau = 1$ it is 0.35% for Nash and 6.04% for the co-operative case.

21 The difference between the case in which the deviation of the instrument from the desired value is an intermediate target, with respect to the case in which it is a target in its own, does not regard the paths of the state and output variables. Both assumptions give rise to the same optimal policy; the difference lies in their welfare evaluation.

22 This can be appreciate by looking at the average and difference reaction coefficients:

signifies that the initial inflation differential is not such as to produce the Miller and Salmon result of the counterproductivity of cooperation; a result which requires a higher initial inflation differential.

It cannot be denied, however, that this counter-example is rather peculiar. The introduction of instrument costs in this model is difficult to justify. We have seen that, in this case, the welfare costs are higher than in the case in which τ=0. Thus either the policy-maker really incurs some costs in changing the interest rate, (costs which have to be made explicit), or it is not clear why the policy-maker should implement a sub-optimal policy by engaging in an overly conservative policy reaction.

2.3. The advantage of cooperation and the real exchange rate

One of the major criticisms that can be made of the Miller and Salmon conclusion concerns the role played by the exchange rate. It goes without saying that one of the main reasons why the international economic policy coordination issue moved to the top of the international agenda was (and partly still is) excessive variability, and the persistent misalignment of the nominal and real exchange rates among the more industrialised countries. By volatility is meant high frequency fluctuations, often inevitable, in the exchange rates around some norm or average value; by misalignment we mean the persistent and cumulative departure from anything which might be recognised as an equilibrium exchange rate, meaning either a rate consistent with purchasing power parity or a rate which would achieve trade balance. The economic consequences of these phenomena are quite different. The exchange rate risk associated with its volatility around some norm can be laid off or hedged against the range of financial instruments currently available. This is not the case of persistent misalignment, which can cause serious misallocations of resources. The latter, moreover, reveals that the foreign exchange market does not behave as efficiently as is too often argued.

From this point of view, the Miller and Salmon model appears rather unsatisfactory. On the one hand, it assumes that the forex market behaves properly and that uncovered interest parity continuously holds; on the other, it denies the fact that one of the objectives of policy coordination is to stabilise exchange rates. In what follows I modify the Miller and Salmon model in order to take full account of the role played by the exchange rate. First I analyse the benefit from cooperation on the assumption that the

---

$$\rho_d^N = 0.357,\ \rho_d^C = 0.254,\ \rho_a^N = 0.625,\ \rho_a^C = 0.800$$

stabilisation of the real exchange rate is one of the explicit targets of the policy maker. I then introduce a very mild form of irrationality in the forex market.

2.3.1. Exchange rate variability in the welfare function

I first begin with analysis of the case in which both policy makers are concerned about the rate of variability of the exchange rate, here proxied by the rate of change of the real exchange rate. The welfare function becomes:

$$(2.3.1.) \qquad W = \frac{1}{2}\int_t^{\infty}\left[\beta\pi^2 + y^2 + \varphi\dot{c}^2\right]$$

Before studying the result of the policy exercise in this case it is interesting to note what can be inferred on a priori grounds. The above objective function yields the following Hamiltonian:

$$H = \frac{1}{2}\beta\pi^2 + \frac{1}{2}y^2 + \frac{1}{2}\varphi\dot{c}^2 + p_z\dot{z} + p_{z^*}\dot{z}^*$$

Along the optimal time consistent path, however, we have $\dot{c} = \theta(\dot{z} - \dot{z})$. Given that $\dot{z} = y$, the Hamiltonian can be rewritten as:

$$H = \frac{1}{2}\beta\pi^2 + \frac{1}{2}y^2 + \frac{1}{2}\varphi\theta^2\left(y - y^*\right)^2 + p_z\dot{z} + p_{z^*}\dot{z}^*$$

With respect to the case in which φ=0 (the Miller and Salmon original case) the difference is not only the greater weight given to y and y*, but also the presence of a term yy* (obtained from the development of the squared term). This new formulation of the welfare function therefore seems to involve a higher degree of interdependence owing to the fact that now both countries share a common target (c^2). This higher degree of policy interdependence may, in principle, increase the returns from coordination.

The results, however, does not confirm this intuition. The closed loop Nash solution provides a superior outcome compared to the cooperative solution, and the welfare ranking does not change when we increase the weight given to the variability of the real exchange rate. The outcome of this experiment is shown in table 2.3.1. Note that the first stable root is equal to that of the benchmark case, while the second is rather lower [23]. This clearly depends on the fact that the behaviour of the system of averages is

[23] It can be shown that the roots obtained from the complete model are the same as those obtained by the average and difference system as long as the model is perfectly symmetric.

not affected by the new formulation of the welfare function: the model is symmetric, so a symmetric shock does not cause the exchange rate to move. The opposite applies to the differences system: the new constraint - that is, the positive cost incurred in varying the real exchange rate - forces the policy maker to implement a less reactive monetary response - the value of the reaction coefficient is noticeably less than in the benchmark case - which in turn brings about a less rapid return to equilibrium, i.e. a lower stable root.

Table 2.3.1.

	Time inconsistent						Time consistent			
	Closed-loop Nash			Co-operative			Closed-loop Nash		Co-operative	
Roots	-0.987	-0.987	-0.483	-1.000	-0.469	-0.469	-0.588	-0.469	-0.600	-0.480
Riccati coefficients:										
θ_1 θ_2 (θ_3)	-0.549	0.549	0.272	-0.506	0.506	0.657	-0.606	0.606	-0.516	0.516
Reaction coefficients:										
ρ_{11} ρ_{12} (ρ_{13})	0.727	0.571	-1.032	0.705	0.629	-0.369	0.491	0.134	0.524	0.276
ρ_{21} ρ_{22} (ρ_{23})	0.571	0.727	0.720	0.629	0.705	-0.369	0.134	0.491	0.276	0.524
Initial values:										
z z*	10.000	0		10.000	0		10.000	0	10.000	0
y y*	-7.216	-2.513		-7.040	-2.960		-6.975	-2.834	-6.605	-3.395
π π^*	9.451	0.549		9.494	0.506		9.543	0.457	9.631	0.369
c	-5.489			-6.372			-4.573		-3.688	
r r*	7.271	5.707		7.051	6.288		7.489	5.596	7.262	6.078
Welfare loss:										
W W*	50.894	4.736					67.293	2.130		
Average	27.816			27.783			29.715		32.298	
Gains from cooperation	0.12%						-8.693%			
Intermediate target loss							27.550		31.207	

On the other hand, the difference between the two reaction coefficients is much smaller than in the case in which φ=0: the less divergent the movement of real interest rates, the less variable the real exchange rate will be. Policy makers, on the other hand, must respond sharply to a change in the foreign state variable, since it affects the real exchange rate. A more lethargic policy response results in higher welfare costs, as repeatedly pointed out. The last but one column of table 2.3.1. shows that when the direct costs of the real exchange rate are also neglected, the exchange rate is considered solely as an intermediate target, the slowdown of the policy reaction itself determines an increase in the welfare costs. In this case too, the decentralised policy can be seen to provide a superior outcome.

The last column shows the negative gains from coordination in percentages. The closed-loop Nash decentralised policy accounts for an eight per cent lower loss than the

cooperative policy, if exchange rate is considered as a final target, and thirteen per cent if the exchange rate is only an intermediate target. Thus the introduction of this new policy objective makes the decentralised policy relatively more attractive. Two other data explain why this happens: the credibility bias evidenced by the difference between the time consistent and the full optimal policy is higher for the cooperative than for the Nash solution (16.25% and 6.83% respectively). Finally, it is worth noting that, in the Nash case, the direct cost derived from deviations of the exchange rate variability from its equilibrium value is higher than in cooperative case (2.17 versus 1.09). This confirms our original intuition that the decentralised policy produces a higher variability of the exchange rate, although this variability seems necessary to reduce the total welfare costs.

2.3.2. The exchange rate level in the welfare function

In this section it is assumed that instead of attending to the variability of the real exchange rate, the policy maker takes the exchange rate as a target in its own. The welfare function becomes:

$$W = \int_t^{\infty} \left[\beta\pi^2 + y^2 + \varphi c^2 \right]$$

where φ represents the weight given to the deviation of the exchange rate from the desired path (assumed to be zero at any time) in the welfare function.

Table 2.3.2. shows the main results when simulating the model on the assumption that the policy maker minimises the above loss function (imposing $\varphi = 1$). As in the case analysed in the previous section, the first stable eigenvalues can be referred to the average system, and the second to the difference system - for the time consistent model. It is evident that the stable root of the difference system is now much higher than in the benchmark case. The level of the real exchange rate is now the policy target, and we have seen that a rapid response to the initial disturbance pays in this model. It is optimal, therefore, to force a higher initial depreciation in order to reduce the initial cost. Unlike the case in which the exchange rate variability is included in the welfare function, now the reaction coefficients are highly divergent. This strong asymmetric response is necessary to minimise the effect of asymmetric shocks on the exchange rate - symmetric shocks, of course, do not have any effect. Note that in this case the effect of the introducing the time consistent constraint has the opposite effect with respect to the benchmark case. Whereas in the latter the full optimal policy was judged not to be

credible because it was too tough - a depreciation was expected to follow - and thus the time consistent policy which discounts these expectations provides a less reactive policy, now the full optimal policy is judged as too mild - a surprise appreciation is expected - and thus the time consistent policy provides a more active response. This effect is clearly more important in the case of cooperative behaviour, since the single policy maker is now entirely able to manoeuvre the exchange rate as desired. One notes that when the *ex ante* optimal policy is considered, the proportional gains from coordination increase markedly with respect to the case in which the role of exchange rate is not considered. As I have already pointed out, our results fit quite well with the results obtained by other researchers.

Table 2.3.2

	Time inconsistent						Time consistent			
	Closed-loop Nash			Coo-operative			Closed-loop Nash		Co-operative	
Roots	-1.076	-1.076	-0.351	-1.000	-5.703	-0.351	-0.967	-1.497	-1.000	-3.434
Riccati coefficients:										
θ_1 θ_2 (θ_3)	-0.868	0.868	0.491	-0.853	0.853	2.135	-1.141	1.141	-1.685	1.685
Reaction coefficients:										
ρ_{11} ρ_{12} (ρ_{13})	1.557	-0.264		2.343	-1.009	1.499	-0.209		3.559	-2.225
ρ_{21} ρ_{22} (ρ_{23})	-0.264	1.557		-1.009	2.343	-0.209	1.499		-2.225	3.559
Initial values:										
z z*	10.000	0		10.000	0		10.000	0	10.000	0
y y*	-11.520	1.826		-14.485	4.485		-12.32	2.647	-22.17	12.167
π π^*	9.132	0.868		9.147	0.853		8.859	1.141	8.315	1.685
c	-8.681			-8.531			-11.411		-16.847	
r r*	15.575	-2.642		23.427	-10.087		14.991	-2.087	35.593	-22.25
Welfare loss:										
W W*	62.264	16.287					68.619	23.580		
Average	39.276			36.213			46.099		55.421	
Gains from coordination	7.799%						-20.22%			
Interm. target loss							24.348		34.760	

Finally, it would be of some interest to address a related issue: how the existence of a exchange rate target affects the bias derived from the lack of credibility of policy maker. By augmenting the costs of changing the exchange rate, we can expect that it reduces the incentive to run a surprise inflation [24]. Therefore we will expect that there is a weight on the exchange rate target small enough not to increase policy inertia but high

[24] It is necessary, however, that the exchange target will be credible. Note that this argument is different from the well known argument about the advantage of *tying our own hands* discussed in the literature on the EMS since in this case the preferences structure is perfectly symmetric.

enough to reduce the credibility bias. Table 2.3.3 reports the welfare results in the case in which an optimal exchange rate targeting is appointed; this means that the weight on the exchange rate is chosen in order to minimise the aggregate welfare losses.

Table 2.3.3

		Home country costs			Foreign country costs			World
	φ	Output	Inflation	Total	Output	Inflation	Total	Average
Full Optimal policy								
Nash closed loop	0	24.256	21.482	45.739	0.027	0.118	0.145	22.942
Coop	0	24.199	21.447	45.645	0.051	0.139	0.189	22.917
Time consistent policy								
Nash closed loop	0	23.222	22.591	45.814	0.023	0.112	0.136	22.975
Coop	0	22.941	22.941	45.881	0.084	0.084	0.169	23.025
Optimal exchange rate targeting								
Nash closed loop	0.1	23.858	21.892	45.750	0.004	0.157	0.161	22.956
Coop	0.075	24.400	21.349	45.749	0.007	0.147	0.154	22.955

Two remarks are in order. The exchange rate targeting allows a reduction of the credibility bias, as was predicted [25]. Therefore it can be seen as one of the way in which the negative consequences of the lack of credibility can be reduced. Moreover, in the case in which a policy of optimal targeting is implemented, there is a slight advantage in running it cooperatively. In this case, in fact, it is possible to reduce the weight on the exchange rate.

2.3.4. Foreign exchange market imperfection and policy coordination

Hitherto I have subscribed to one of the Miller and Salmon's most important assumptions: that the foreign exchange market works efficiently and that the open interest parity condition continuously holds. I have already pointed out, however, that this assumption is not completely satisfactory and has been extensively questioned from an empirical point of view. It would be beyond the scope of the present paper to analyse the reasons for this conclusion; suffice it to say that the above assumption encompasses three others: perfect capital mobility, perfect substitutability between domestic and foreign assets, and the hypothesis of rational expectations.

Given perfect capital mobility, rejection of the open interest parity condition can, therefore, in principle, result from the rejection of rational expectations hypothesis and/or from the rejection of the absence of a (time varying) risk premium. Looking at the more

[25] This intuition is confirmed by the observation that no reduction of the welfare losses comes out when an exchange rate targeting is implemented by a policy maker able to run the full optimal policy.

recent empirical literature a result clearly emerges: "*the uncovered interest parity condition is resoundingly rejected for the recent experience with floating exchange rates*" (Mac Donald and Taylor, 1992) [26]. It is less clear whether this result is due a violation of risk neutrality or a failure of rational expectations. The recent availability of survey data allowed researchers to conduct tests separately on each component of this joint hypothesis. By and large, the conclusion of this new line of research is that the joint hypothesis fails both because agents are risk averse and because their expectations do not comply with rational expectations hypothesis [27]. However, it has been argued that the explanation based on the expectations failure appears far more persuasive (see, among the others, Frankel and Thaler, 1990).

The results of the empirical literature points to the conclusion that the uncovered interest rate condition is no longer a sound foundation for an exchange rate model and for a model of international economic interdependence. Although for some purposes this assumption can be retained for the sake of simplification, it must be discarded regarding the economic policy coordination issue since in this case the correct working of the exchange rate market is crucial in obtaining the counterproductivity result. Firstly, the market efficiency assumption allows the policy maker to neglect the exchange rate as a policy target, secondly the augmented credibility bias of the coordinated policy relies on the role played by the exchange rate as the forward-looking variable. Therefore analysis of the topic of policy coordination may prove interesting once the assumption of efficiency in the foreign exchange market has been relaxed.

This section introduces a very simple form of market inefficiency: namely a fad which induces the exchange rate to deviate from the value implied by the behaviour of fundamentals[28]. The exchange rate equation becomes:

$$\dot{c} = r - r^* + f$$

where f represents the fad, whose dynamic is

$$\dot{f} = \alpha f \quad f(0) = f_0 \text{ with } \alpha < 0$$

where α is a parameter measuring the speed of convergence or decay of the fad. We assume that fads are rational, in the sense that the role, indeed irrational, played by the

[26] To whom the reader interested in more detail and in the appropriate references is referred.
[27] See the literature surveyed in Takagi, 1991
[28] Fads are mean reverting deviations from intrinsic value caused by social or psychological forces such as those that determine fashions in political beliefs and consumption goods, or like Keynes' *animal spirits*.

fad is correctly anticipated by the private agents. This assumption can be justified by recalling the old Keynesian metaphor for investment activities as a beauty contest in which the winner is the person whose choice comes closest to the average choice (Keynes 1936). Beauty contest fads may persist if there is some institutional or psychological incentive for traders to coordinate their actions. [29]

The main difference from the original version of the model is that now the exchange rate is no longer a pure forward-looking variable, since the presence of the fad adds a backward component. The balance between the backward and the forward component of the real exchange rate depends on the value of α and of f_0. The latter factor indicates the initial dimension of the fad phenomenon, while the former indicates its degree of persistence. Both tend to enhance the backward component of the dynamics of the real exchange rate.

The direct effect of the fad is to create a misalignment in the exchange rate, which in turn boosts aggregate demand and core inflation in the domestic country, while the effect on the foreign country is obviously the opposite. Moreover, it is interesting to note that the shock represented by the onset of the exchange rate fad, and in particular the consequent misalignment of the exchange rate, can be also interpreted as partially similar to a real shock. In fact, it affects the aggregate demand of both countries in a perfectly asymmetric way (see eq.1.3.1). It is generally suggested by the literature on policy coordination that while gains from coordination are doubtful in the presence of monetary shocks, they are more likely to emerge when real shocks are considered [30]. However, it should be remembered that, as far as time consistent equilibria are concerned, the distribution of shocks is more important that their intrinsic nature in determining the existence of gains from cooperation.

Finally, it is worth stressing that the particular shock analysed here is similar but not fully equivalent to a more generic real shock. Its interesting feature is the fact that it originates from the exchange rate market, and this market plays a crucial role in causing the counterproductivity of cooperation. It is of some interest to investigate whether this result is robust in the presence of an imperfect foreign exchange market.

---

[29] Portfolio managers are often fired if their short-run performance is worse than overall market performance, which dulls the incentive for speculation necessary to destroy fads (see Camerer 1989).

[30] See, among the others, Carraro and Giavazzi, 1987. They show that a co-operative policy is definitely counterproductive until a symmetric productivity shock is considered.

As long as a form of irrationality is present in the exchange rate market, it is more difficult to justify the neglect by the policy authority of the behaviour of the exchange rate. The exchange rate is now partially governed by irrational factors which may drive it far out of equilibrium. We therefore assume that the policy maker is concerned with the value of the real exchange rate, and with its variability. The relevant welfare function is the following:

2.3.1) $$W = \int_t^{\infty} \left[\beta\pi^2 + y^2 + \tau\left(\dot{c}^2 + c^2\right) \right]$$

This new formulation of the welfare function allows us to consider both the volatility costs proxied by the term $\dot{c}^2$ and the misalignment costs proxied by the term c^2. Both are evaluated as deviations from the optimal values - clearly zero in both cases.

In what follows, I focus on *time consistent* solutions computed using the Cohen and Michel procedure. In this case, the time consistent constraint should take into account the newly introduced state variable f. I have, in fact, assumed that the fad process is completely known to private agents, and they thus use it to anticipate the behaviour of the policy maker. The time consistent constraint becomes: $c = \theta_1 z + \theta_2 z^* + \theta_3 f$.

2.3.4.1 Policy coordination in the presence of a fad

In this section I study the case in which the only shock affecting the two economies is the onset of a fad. As regards the fad, we assume that α=-0.25 and the initial value of the fad is 5 (f_0=5). The value of the coefficient τ, that is, the weight attached to the variability and the misalignment of the exchange rate, is set at 0.5. Table 2.3.4. summarises the main findings.

The dynamic of the fad is, clearly, independent of the policy adopted: the third eigenvalue reported in table 2.3.4. refers to the fad. Differences between policies thus regard the different adjustment paths for the other variables given the behaviour of the fad. The table presents the value of the reaction coefficients which link the instruments r and r^* to the state variables along the optimal feedback, time consistent path:

2.3.2) $$\begin{bmatrix} r \\ r^* \end{bmatrix} = \begin{bmatrix} \rho_{12} & \rho_{12} & \rho_{13} \\ \rho_{21} & \rho_{22} & \rho_{23} \end{bmatrix} \begin{bmatrix} z \\ z^* \\ f \end{bmatrix}$$

Table 2.3.4.

	Closed-loop Nash			Cooperative		
Roots	-0.975	-0.652	-0.250	-1.000	-0.473	-0.250
Riccati coefficients:						
θ_1 θ_2 θ_3	-0.656	0.656	-0.460	-0.510	0.510	-0.444
Reaction coefficients:						
ρ_{11} ρ_{12} ρ_{13}	0.864	0.437	-0.437	0.787	0.546	-0.445
ρ_{21} ρ_{22} ρ_{23}	0.437	0.864	0.437	0.546	0.787	0.445
Initial values:						
z z*	0		0	0		
y y*	-0.045		0.045	0.0007		-0.0007
π π^*	-0.230		0.230	-0.222		0.222
c	-2.302			-2.220		
r r*	2.182		-2.182	-2.223		2.223
Welfare loss:						
W W*	3.407		3.407			
Average	3.407			2.672		
Gains from coordination	21.6%					

The optimal reaction for the domestic country to the initial real exchange rate depreciation is to implement a severe monetary policy, i.e. to raise the interest rate, while the foreign country which faces the opposite shock will reduce its real interest rate. The increase in the real interest rate will reduce both the initial depreciation of the real exchange rate, induced by the fad, and its consequences on core inflation and real income.

It is evident that, in this model as in the original Miller and Salmon one, a quicker response to the initial shock will pay. The cooperative solution allows a more rapid reaction to the onset of the fad. The explanation for the slower response in the Nash equilibrium is that the domestic country reckons that, by increasing the interest rate, it will pay a cost in terms of a temporarily high real exchange rate (loss of competitiveness) and consequently in terms of real income and core inflation. Therefore the domestic country will somewhat relax the severity of its policy. Symmetric reasoning applies to the foreign country. Both fail to consider the externalities of their policy. A cooperative policy maker is able to run a tighter policy, since it explicitly considers the cross-countryeffects of the monetary restriction and thus obtains a more rapid return to equilibrium.

Figure 2.3.1.a and 2.3.1.b show the behaviour of the real income and compare Nash and cooperative policy, while figure 2.3.2a and 2.3.2.b compare the path of the core inflation. It is evident that the cooperative policy outperforms the decentralised one by yielding a path of the target values much closer to the desired one.

Figure 2.3.1.a

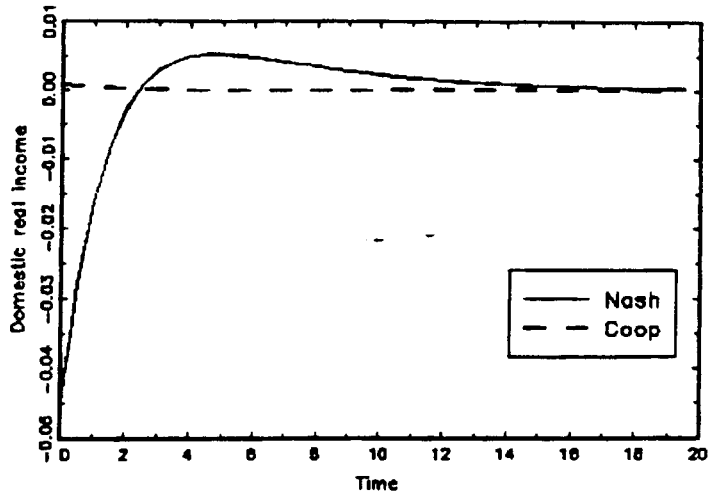


Figure 2.3.1.b

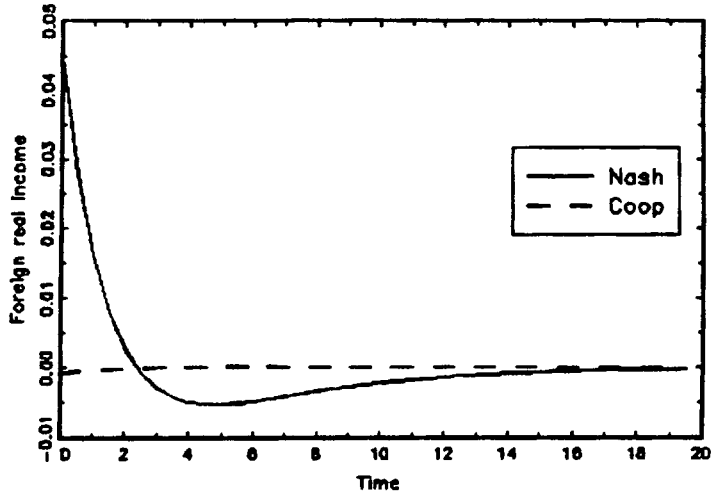


Figure 2.3.2b

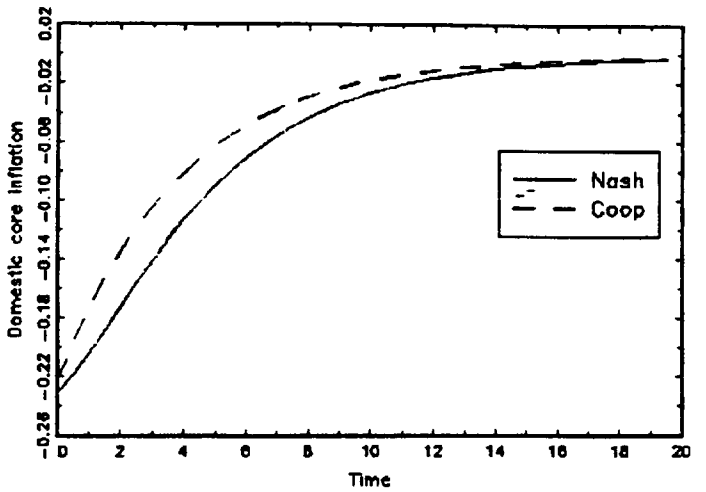
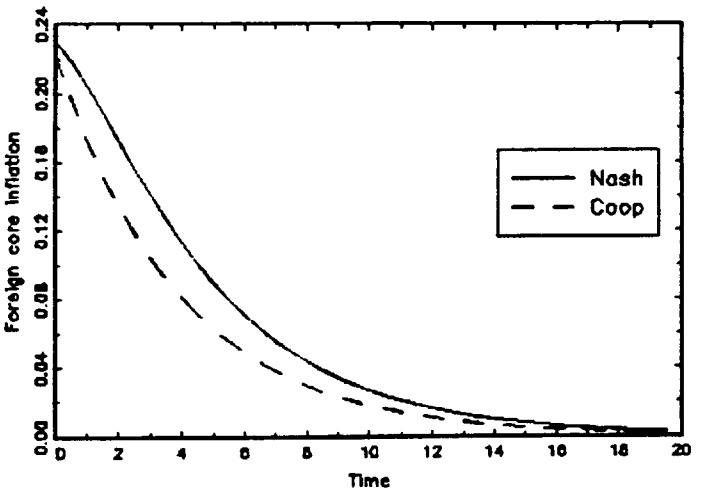


Figure 2.3.2.b



It is worth noting that the gains from coordination change when modifying some of the parameters of the model. First of all, it is evident that, if we assume that $\tau=0$ - that is, policy makers do not consider either exchange rate misalignment or exchange rate variability as a target of policy - no gains from coordination can emerge. This case would be equivalent to that in which the two economies are hit by an asymmetric demand shock. However, neglect of the exchange rate as a target of policy is not justified by the model assumption; and specifically by the imperfect nature of the exchange rate market. Moreover, even very little weight given to exchange rate stabilisation in the welfare function brings out the gains from coordination [31] and the gains from cooperation increase with the increase in τ. Secondly, while the total cost, both in the Nash and cooperative case, are an increasing function of the initial dimension of the fad phenomenon (f_0), gains from coordination remain constant with respect to the fad dimension. That is not surprising, since the model is linear and the onset of the fad is the only shock. Finally, gains from cooperation tend to increase with the increase in α; that is, the parameter measuring the speed of convergence of the fad. The more the fad is a persistent phenomenon, the less gains from cooperation will emerge. This result can be explained as follows. The advantage of the cooperative response consists in a more rapid average response to the initial shock. Therefore the difference between the Nash and the cooperative solution emerges more conspicuously, the more concentrated the shock is in the first period. The level of both the Nash and the cooperative welfare cost, obviously, increases with the increase of α.

In conclusion to this section, one may say that in the presence of a fad in the foreign exchange market - that is, in the case in which this market displays some kind of disturbance which drives it far from efficiency - international policy coordination is the best way to cope with it. More importantly, this result is still true if one assumes that policy makers lack credibility and are forced to adopt a time consistent policy.

2.3.4.2. Policy coordination in the presence of an inflation shock

In this section, an asymmetric inflation shock is introduced. This will enable my results to be compared with those obtained by Miller and Salmon. In order to facilitate this comparison, I choose the same numerical values: $z(0) = 10$, $z^*(0)=0$. In other words, the domestic country faces a dramatic upsurge in inflation, due to past excess demand, while

[31] The lowest level I assigned to τ during the simulation was 0.001. In this case co-operative solution yields a superior outcome with respect to Nash policy.

the foreign country is not directly affected by the inflation shock. Along with this initial shock, we still have our fad onset (f(0)=5)[32]. Table 2.3.5. shows the main findings of this experiment.

As previously noted, the fad dynamic follows a process independent of the policy adopted. The analysis of the reaction coefficients suggests that, in the cooperative solution case, they are larger on average with respect to the Nash case and more equally distributed among countries. In particular, the reaction coefficient with respect to the fad - that is, the policy reaction to a backward component of the exchange rate dynamic - is higher under cooperation: this means that the policy coordinator is able to run a more severe policy since it internalises the external effects of national policies.

Table 2.3.5

	Closed-loop Nash			Cooperative		
Roots	-0.975	-0.652	-0.250	-1.000	-0.473	-0.250
Riccati coefficients:						
θ_1 θ_2 θ_3	-0.656	0.656	-0.461	-0.511	0.511	-0.441
Reaction coefficients:						
ρ_{11} ρ_{12} ρ_{13}	0.864	0.437	-0.436	0.788	0.546	-0.445
ρ_{21} ρ_{22} ρ_{23}	0.437	0.864	0.436	0.546	0.788	0.445
Initial values:						
z z*	10	0		10	0	
y y*	-8.181	-1.569		-7.366	-2.633	
π π*	9.114	0.885		9.268	0.732	
c	-8.858			-7.323		
r r*	6.458	6.549		5.655	7.684	
Welfare loss:						
W W*	75.191	20.649				
Average	47.919			44.577		
Gains from coordination	7.50%					

The main difference with respect to the original Miller and Salmon model is the fact that the cooperative response to initial shocks now pays. It should be noted, firstly, that the reversal of the welfare ranking and the return to productivity of cooperation depends on the introduction of the fad process. In fact, if we re-run the experiment without the fad, we once again obtain the Miller and Salmon result, even if we preserve

[32] The presence of a depreciation fad may be justified on the grounds that private agents do not completely believe the policy announcement of the authority and thus expect a much slower response to the initial shock.

our welfare function specification[33]. It is of obvious interest to seek an explanation for this result.

As noted in the second section, in the presence of a fad the real exchange rate is no longer a pure forward-looking variable. The presence of the fad, in fact, introduces a backward-looking component into the dynamic of the real exchange rate. The importance of this backward-looking component is measured by the parameter α. The closer α is to zero - that is, the slower the process of fad absorption - the more weight is given to the backward component of the real exchange rate dynamic. Table 2.3.6 shows the welfare losses, for cooperative and decentralised policies, assuming different values for the parameter measuring the speed of convergence of the fad. The total welfare cost decreases with the increase in α. The lower α is - that is, the slower the absorption of the fad - the more lasting the consequences on the paths of the exchange rate, core inflation and real income will be.

Of more interest is the finding that the advantage deriving from coordinating national economic policies clearly increases with the decrease in the value of α. When the value of α rises, the backward element in the dynamics of the real exchange rate loses its significance, and the cooperative response loses its appeal. Were the value of α high enough, a reversal in the welfare ranking would appear and a result similar to that obtained by Miller and Salmon would appear.

Table 2.3.6

Value of α	Welfare loss Nash	Coop	Gains Coop
0.15	52.03	48,26	7.81%
0.25	47.91	44.57	7.50%
0.5	43.38	41.23	5.22%
1.0	39.79	38.81	2.53%
1.5	38.18	37.70	1,27%
2.5	36.65	36.63	0.06%
3.0	36.23	36.32	-0.25%
3.5	35.91	36.09	-0.50%

We may therefore conclude that the existence of gains from coordination depends on the value of α. Once we relax the hypothesis of the efficiency of the foreign

[33] On the other hand, it cannot be denied that, as noted in the previous section, this result crucially depends on the positive weight given to exchange rate in the welfare function. However, even very low values of τ are able to generate the superiority of co-operation: gains from coordination emerge when τ is greater than 0.06.

exchange market, the degree of imperfection of the foreign market is a crucial element in evaluating the merits of cooperation. The more imperfect the foreign exchange market, that is, the more persistent the fad process, the more likely it is that policy coordination will yield a superior outcome.

Our results partially modify those obtained by Miller and Salmon in an important respect. The degree of correlation of shocks is the only element to consider, only if we assume that the foreign exchange market behaves perfectly without any form of disturbance. On the contrary, if we, more realistically, introduce a form of imperfection in the foreign exchange market, and assume that policy makers care for exchange rate stabilization, the degree of correlation between shocks is no longer the only element to consider, since the degree of imperfection gains particular significance in discriminating between productive and counter-productive international economic policy cooperation.

2.4 Policy myopia and policy coordination

We have assumed that the policy maker does not display "myopic" behaviour and does not value future costs at less than current costs. In technical terms, we have assumed that the discount rate of future costs is zero, so that the discount factor is one. It is clearly of some interest to see what can happen to Miller and Salmon's model when we relax this hypothesis and assume that the discount rate is greater than zero. Under this assumption the welfare function becomes:

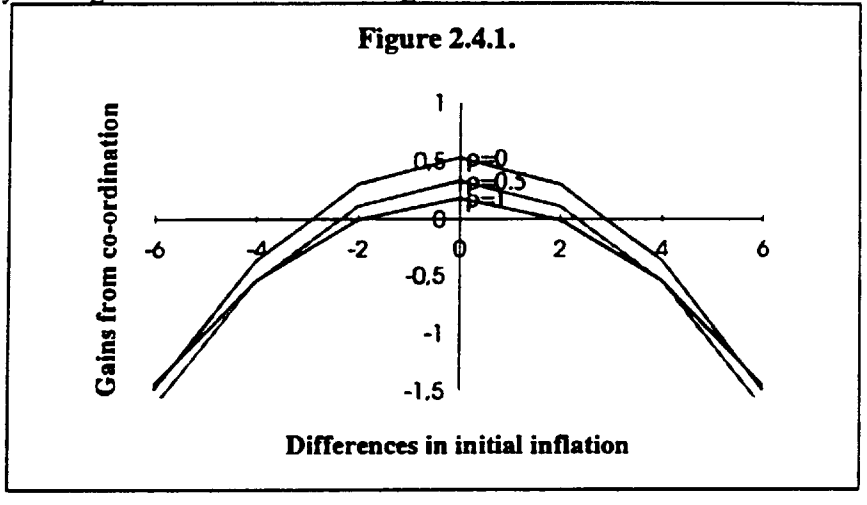
2.4.1. $$W = \tfrac{1}{2}\int_0^{\infty} e^{-\rho t}\left[\beta\pi^2 + y^2\right]dt$$

The most important consequence of introducing a positive discount rate is to induce a more lethargic policy response to the initial shock. If the policy maker values future costs less than the present ones, then it is optimal to shift some of the burden of adjustment towards the future by responding less sharply to an initial inflation displacement. Therefore, it can be said that discounting exacerbates the inefficiency of the time-consistent policy relative to the full optimal rule. It is to be verified, however, whether this worsing effect influences more Nash or cooperative solution. Miller, Salmon and Sutherland (1991) show that, when initial inflation rates differ, discounting increases policy lethargy relatively more for the Nash policy maker than for the coordinator. This would make coordination more attractive. However, when considering common inflation shocks, the inefficiency implied by the Nash policy, due to the presence of the externalities, decreases as discounting increases and this would make the Nash policy

more acceptable. They find the balance between these two elements to move against policy coordination as discounting increases. In a stochastic framework, they find that the critical correlation coefficient - that is, the value of the correlation coefficient that can switch the welfare ranking in favour of cooperation - tends to increase with the increase in discounting.

Support for this thesis is provided by looking at figure 2.4.1., where the gains from coordination are plotted against the difference in initial inflation rates. Each curve is obtained using a different discount rate (ρ). It is evident that if time consistent policies are considered, for any given initial distribution of inflation shocks, coordination is less likely to pay the higher the rate of discounting.

Figure 2.4.1.



It is worth pointing out that the temporal redistribution of loss allows a decrease in the total welfare loss when this is evaluated taking into account that the discount is now positive. In this framework, however, a slower response is no longer clearly inefficient because the discount rate is positive. Therefore the higher cost implied by a slower response must be balanced against gains in terms of welfare obtained by postponing part of the cost to the future. This positive effect immediately disappears when we evaluate the same policies assuming that policy myopia is absent: that is, if we revert to the case in which ρ is zero. In this case the more lethargic response brings about a higher welfare loss.

2.5. The form of the cooperative solution

Following Miller and Salmon, in the previous sections the cooperative welfare function was defined in a very standard and general form as the weighted average of the domestic and foreign welfare functions:

2.5.1. $W_c = \omega W + (1 - \omega) W^*$

This definition does not supply an unique cooperative solution, but rather a class of cooperative solution according to the value given to ω. In their papers Miller and Salmon arbitrarily assign ω the value of 0.5, assuming therefore that the two countries have the same bargaining power. In this section I shall verify whether this choice is adequate for the analysis that Miller and Salmon and myself carry out and whether the result of the counter-productivity of cooperation is affected by the value given to ω.

A sort of prerequisite for cooperation to be possible is that players should be able to discuss the situation and agree on a rational joint plan of action. Eventually the agreement reached must be made binding and enforceable by the rules of the game [34]. Two stages, thus, emerge. In the first, an agreement must be reached. However, many different agreements are in theory possible, and it is here that the problem of bargaining arises. In the second stage, whatever agreement has been reached should be made binding. In what follows I shall concentrate on the first stage, assuming that some kind of binding agreement already exists [35].

Two different approaches to bargaining have been proposed in the literature (Petit, 1990):

a) the strategic approach, where a bargaining process is explicitly described and where the negotiation between the players takes place in the context of a non cooperative game (see Rubinstein, 1982).

b) The axiomatic approach where no bargaining process is considered (see Roth, 1979 for discussion of axiomatic models).

In these terms, the axiomatic approach may appear rather unsatisfactory, unless the existence of an arbitrator is assumed. Players submit their disputes to the arbitrator or coordinator who solves the bargaining problem and provides a solution. If this arbitrator exists, then an explicit description of the bargaining process is redundant. In the context of the international policy-making game, however, the assumption of the existence of an

34 The fundamental distinction between co-operative and non co-operative games is that co-operative games allow binding agreements while non co-operative one do not (Friedman 1986, page. 148).

35 Although this convenient assumption allows us to devote more attention to the main topic of our inquiry, it is not completely satisfactory.

arbitrator would not seem as heroic as it would in a different context [36]. In a context of a dynamic game, moreover, the problem of "cheating" - that is, unilateral deviation from the agreement - emerges, which makes the presence of an arbitrator essential for enforcement of the agreement [37].

The behaviour of the arbitrator, however, cannot be *arbitrary*, but should instead follow an "arbitration scheme". Different cooperative solution concepts can be distinguished on the basis of a set of axioms that arbitration schemes must fulfil.

One basic axiom that every cooperative solution must satisfy is *Pareto optimality* - no country can improve its outcome without worsening the situation of the other - known in bargaining theory as *group rationality* - it would be irrational for the countries as a group to cooperate on a non-Pareto optimal policy. A Pareto optimal cooperative solution can be obtained by assuming that our arbitrator minimises the weighted sum welfare function 2.5.1.

This general approach has two majors shortcomings. It does not produce a unique cooperative solution: by varying the value of ω, a set of Pareto optimal solution may be obtained. It does not assure *individual rationality*; in other words, it does not guarantee that the welfare losses of the cooperative policy are less than those of the non cooperative one for each country. Miller and Salmon handle the first problem by giving ω the value of 0.5, thus weighing the two countries in the same way. Since the two countries are perfectly symmetric, this assumption does not appear inappropriate on theoretical grounds. What is of more interest is that the lack of individual rationality makes a perverse outcome possible: for one of the two countries the welfare losses under cooperation may be greater than under the Nash solution thereby precluding cooperation on this basis. This arises an important question. Is it realistic to assume that two sovereign countries will implement a cooperative policy when this does not guarantee that both countries will obtain an outcome superior with respect to that achievable with a non-cooperative policy? A negative answer to this crucial question leads to the conclusion that the form of cooperation proposed by Miller and Salmon would not be the most appropriate, and that it should not be used to analyse the benefits from cooperation. Moreover, in this framework the issue of sustainability of cooperative regimes regains

36 What is the European Central Bank in the context of the European monetary union if not an arbitrator?

37 On the other hand, if we consider dynamic games with memory, sustainability can be achieved endogenously if players use *trigger strategies*.

crucial importance since, in the case in which individual rationality is not ensured, one country has the incentive to renege on the joint plan and to revert to Nash policy.

In order to verify the importance of this aspect I run a simulation with a minimal variation with respect to that of the Miller and Salmon paper [38]. The solution concept proposed by Miller and Salmon yields the welfare values shown in table 2.5.1.

Table 2.5.1

	Time consistent		Full optimal policy	
Losses	Closed-Loop Nash	Cooperative	Closed-Loop Nash	Cooperative
Domestic country	55.884	55.953	55.805	55.691
Foreign country	1.071	1.098	1.091	1.144
Average losses	28.478	28.526	28.448	28.418

In the case of the *ex ante* optimal policy, foreign country lacks any incentive to cooperate; the reason is, quite obviously, the asymmetrical initial distribution of shocks. The foreign country is hit only by a minor shock with respect to the shock affecting the domestic economy. It is well known that the advantage of cooperation consists in the internalisation of policy externalities. The two countries agree on a cooperation plan by mutually renouncing their attempts to export some of their adjustment costs: in other words, each country exchanges its own policy external effect for the external effect of the other country. In this case, however, the external effects of decentralised policies are not symmetric because initial shocks are not symmetric. Hence the exchange is unequal. The cooperative solution with $\omega=0.5$ would simply mean for the foreign country to bear some of the other country adjustment costs.

In the case of time consistent solution, instead, both countries are worse off when they decide to cooperate by setting $\omega=0.5$. Here none of the two countries would never enter this kind of agreement. Therefore, with strongly asymmetric shocks, both time inconsistent full optimal policy and time consistent policy are not sustainable [39]. Moreover, it is transparent that ω must be changed in favour of the country hit by a smaller shock, that is the foreign country. Table 2.5.2. shows the value of the welfare losses with different values of ω. In the case of ex ante full optimal policy the behaviour

38 For easier computation of the cost incurred by each country under co-operation, we assume that $Z(0)=11$ and $Z^*(0)=1$.

39 There are two aspects of the sustainability problem to be considered. The first is the familiar credibility problem deriving from the possibility of cheating the private sector and the second is whether the two countries will honour the cooperative agreement with each other.

of the welfare losses is coherent with the expectations: the domestic losses monotonically decrease and the foreign losses monotonically increase with the increase in the weight assigned to the domestic welfare function. It is interesting to note that, on the contrary, in the case of the time consistent policy, the behaviour is different: both domestic and foreign losses decrease when ω goes from 0.05 to 0.1 and foreign losses continue to decrease until ω reaches 0.25. This behaviour that may appear counterintuitive, can be easily rationalise if we realise that the increase in the value of ω yields two different effects: the first is the standard one, that is the welfare of the domestic country is more considered and then its welfare losses decrease; the second is peculiar to time consistent solution: to increase the value of ω means to increase the aggregate credibility bias. The reduction of the credibility bias improves the welfare results for both countries. This result is rather important although it has not been noticed in previous studies (see Currie and Levine, 1987 for example), because it shows that cooperation with a lower value of ω can been seen as a way of reducing the bias induced by the lack of credibility of the government.

Table 2.5.2

	Time consistent		Full Optimal policy	
ω	Domestic country	Foreign country	Domestic country	Foreign country
0.05	55.95138	1.08476	56.90712	1.04321
0.1	55.84973	1.07502	55.91173	1.06509
0.2	55.88204	1.06963	55.79699	1.08316
0.25	55.89701	1.06916	55.77483	1.91520
0.3	55.90980	1.06998	55.76077	1.09506
0.4	55.93166	1.07242	55.72960	1.11194
0.5	55.95336	1.09823	55.69138	1.14377
0.6	55.97926	1.15322	55.63632	1.21261
0.7	56.01690	1.30625	55.54605	1.38542
0.8	56.08739	1.84340	55.36817	1.94824
0.9	56.29166	5.29777	54.85042	5.30549

2.5.1 The rational bargaining solution

In this section I compute a different cooperative policy based on rational bargaining behaviour. The standard bargaining theory is based on the Nash bargaining model (Nash, 1953). In addition to Pareto optimality, it must also satisfy four axioms: individual rationality, independence of irrelevant alternatives, symmetry and independence with respect to utility (linear) transformation (see Friedman, 1986 chapter 5 for details). Particularly relevant to our purposes here is the first axiom, which implies

that a rational policy maker would never accept an agreement the outcome of which would be worse than he could obtain by acting competitively. This axiom restrict the domain of the solutions that satisfy group rationality to a smaller set called the negotiation set.

It has been shown that there is an unique solution that satisfies all the four axioms and is obtained when the Nash product - that is the product $[(W_C - W_N)(W_C - W_N)]$ of the cooperation gains from the treat point - is maximised.

In our example the Nash bargaining solution is obtained for a value of ω equal to 0.185. The results are presented in table 2.5.3. Firstly, one notes that ω is less than 0.5; this means that in order to take advantage of cooperation, the domestic policy-maker must renounce part of his policy sovereignty. In fact the coordinator must evaluate its welfare function less than the foreign one: only in this way can the arbitrator implement a rigorous policy which induces a return to equilibrium faster than that of the Nash decentralised case.

Table 2.5.3.

	Closed-Loop Nash		Co-operative		Nash bargaining	
Roots	-0.972	-8.882	-1.000	-0.842	-1.029	-0.824
Riccati coefficients:						
θ_1 θ_2	-0.820	0.820	-0.790	0.790	-0.813	0.707
Reaction coefficients:						
ρ_{11} ρ_{12}	1.012	0.284	0.999	0.334	1.012	0.520
ρ_{21} ρ_{22}	0.284	1.012	0.334	0.999	0.292	0.999
Initial values:						
z z*	11.000	1	11.000	1	11.000	1
y y*	-10.270	-1.388	-10.210	-1.790	-10.431	-1.461
π π^*	10.180	1.820	10.210	1.790	10.177	1.823
c	-8.199		-7.899		-8.235	
r r*	11.416	4.134	11.329	4.679	11.655	4.208
Welfare costs:						
W W*	55.884	1.071	55.953	1.098	55.877	1.069
Average #	28.478		28.525		28.473	
Gains from coordination			-0.50%		0.02%	

Note : # The average welfare costs are computed with the original weights of 0.5

The table shows that the cooperative solution in this case provides a stronger policy reaction with respect to both the cooperative policy outlined by Miller and Salmon and, more importantly, the Nash decentralised solution. Inspection of the values of the reaction coefficients shows that the Nash bargaining solution implies a response to symmetric shocks higher than in the cooperative and Nash case, and a response to asymmetric shocks far higher than in the cooperative case and a slightly lower than in the

Nash case. Therefore, with the cooperative solution obtained using the Nash bargaining model, the superiority of cooperation would be stated.

Analogous result was obtained by Currie and Levine (Currie and Levine, 1987). However, they were interested in a different issue: they were interested in verifying whether the *ex ante* full optimal cooperative policy were sustainable in a deterministic setting. They concluded that there is no choice of ω that makes the *ex ante* full optimal cooperative solution sustainable since there is no choice of ω which sustain it against both the non-cooperative time consistent and non-cooperative *ex ante* full optimal policy. Their result relied on the assumption that both Nash time consistent and Nash *ex ante* full optimal, but time inconsistent, policy are regarded as possible non-cooperative alternatives or threats following a breakdown in the cooperative agreement.

My perspective is different. In a world in which policy makers lack credibility to implement the ex ante full optimal policy, both countries can improve their welfare by cooperating using a Nash Bargaining procedure and this cooperative solution is sustainable since there are no incentive in reneging vis a vis the private sector - we limit to time consistent solution - and both countries are the incentive to enter the agreement.

The advantage of this approach is that it introduces, at least indirectly, a form of bargaining [40]. The existence of a coordinator may be postulated, but since the players here are sovereign countries, participation in a joint accord can only be voluntary, and must therefore yield mutual advantage. If this accord is to be reached both countries must offer something, but because of the extreme asymmetry of shocks the foreign country has very little to offer in terms of external effects. Only a cooperative solution procedure that does not assume a priori the equality of welfare weights between the two countries can demonstrate the advantage of cooperation.

2.5.2 The benefit from cooperation

From what has been said there seem to be a number of advantages to cooperation, given that, when properly computed, the cooperative solution is superior to the Nash solution[41].

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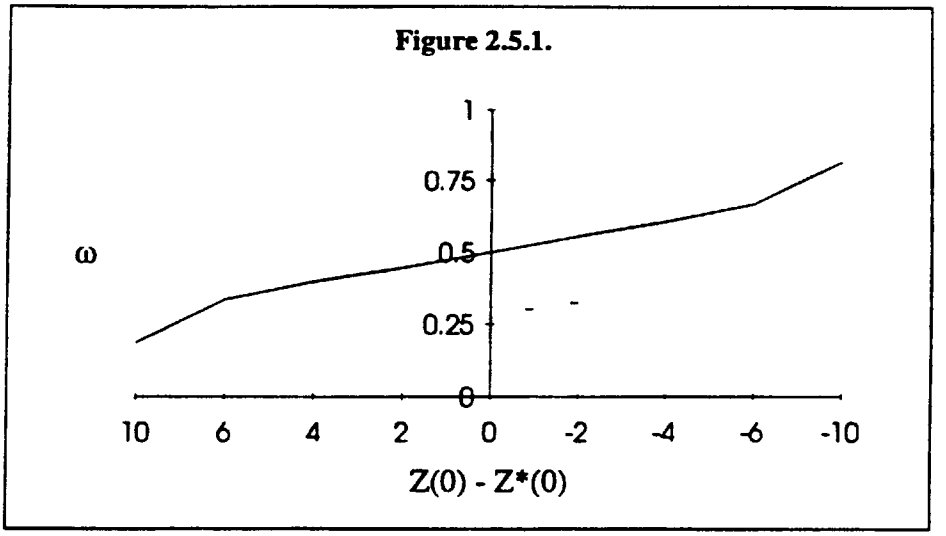
40 A non co-operative or behavioural foundation, rather than an axiomatic one, has been recently been provided for the Nash bargaining solution (see papers collected in Binmore and Dasgupta, 1987), although it is not yet clear how it can be extended to a differential-game framework.

41 It must be stressed, however, that there is still the possibility that the negotiation set is empty and that a Nash bargaining solution does not exist. I found that this is the case if one country is hit by a remarkable shock while the shock affecting the other country is zero.

From a logical point of view, however, the argument set out in the previous section may appear rather tautological. Two players are engaged in the policy game: in order to obtain the sub-optimality of cooperation, at least one of them must suffer a decrease in welfare by moving from the Nash to the cooperative solution. Ruling out this possibility means ruling out the sub-optimality of cooperation by assumption. The tautology, however, is only apparent. The perverse result on sub-optimality of cooperation has been justified on theoretical grounds by arguing that the cooperative solution is nothing but a coalition between the two policy-makers at the expense of the third implicit player: private agents. My point is the following: why should one country enter a coalition if it leads to a decrease in its welfare with respect to Nash decentralised equilibrium?

A second objection can be raised here. The argument is convincing only on the assumption that countries can decide whether to cooperate after they have gathered information on shocks. On the contrary, it loses its appeal if the decision whether to cooperate has to be taken before information on shocks is available. This well founded objection suggests that the Miller and Salmon conclusion should be amended. The Miller and Salmon analysis is important for determination of the critical value of the degree of correlation between shocks that can switch the welfare result from the productivity to the counter-productivity of cooperation. What matters is the probability of having highly correlated shocks, that is, shocks with a degree of correlation above the critical value. Therefore the optimal political strategy that can be deduced from the Miller and Salmon approach is this: cooperate if the probability of having closely correlated shocks is high enough to provide both countries with an incentive to cooperate and to ensure the productivity of cooperation; otherwise do not cooperate. We show that there is a strategy that clearly dominates that proposed by Miller and Salmon: namely cooperation using a Nash bargaining solution as cooperation procedure. In this framework, it is evident that the Nash bargaining solution - that is the value of ω - will be different according to the difference in the initial inflation shocks. The higher the difference between the domestic and the foreign initial inflation disturbances, the lower the value of ω.

Figure 2.5.1.



2.6 Concluding Remarks

In this chapter I have conducted a sensitivity analysis of the Miller and Salmon conclusion of the counter-productivity of cooperation. To a large extent, their statement has proved to be rather robust. Nevertheless, some flaws in their reasoning have been identified and some interesting findings, more favourable to cooperation, have been obtained.

Particularly relevant it is the result of the undesirability of cooperation even when it is assumed that the central planner is the best *conservative* policy maker. This assumption reduces the time consistent bias of the cooperative solution but not enough to render it preferable to the competitive decentralised policy in which policy makers share the same attitude against inflation as the median voter. This suggests that the way of reducing the time consistent bias proposed by Rogoff cannot be of any help in rendering cooperation more attractive [42]. Nonetheless, it has been shown that a very mild form of cooperation represented by the cooperative choice of the *conservative* banker' preferences is desirable. Explicit consideration of the costs of changing the policy instruments and of the exchange rate as target of policy does not change the ranking between cooperative and Nash solutions; the counter-productivity argument is thus confirmed. Furthermore, if we assume that the policy maker displays myopic behaviour and then the rate of discount

[42] In their paper Miller and Salmon (1989) suggest rendering the cooperative solution more attractive by "misrepresenting" coordinator preferences via the appointment of a secretariat within the coordinating authority with views that are not simply an average of the national countries. My analysis shows that this answer can ameliorate the situation without rendering cooperation preferable to decentralised policy.

is greater than zero, coordination is less likely to pay the higher the rate of discounting. Also, if we consider the exchange rate to be one of the policy targets, assuming that the stabilization of the exchange rate may be one of the goal of international policy coordination, it proves impossible to reverse the welfare ranking obtained by Miller, Salmon and Sutherland.

However, two major points of attack of the counter-productivity argument have been identified. First of all, if we relax the assumption that the exchange rate market is perfectly efficient and we introduce, even a mild form of imperfection in the exchange rate market, we find that cooperation pays. Secondly, we have seen that when the simple definition of the cooperative solution proposed by Miller and Salmon is replced by a rational bargaining approach to the cooperative solution, it turns out that the cooperative solution is preferable to Nash solution. These two results suggest that the counter-productive argument is not as general as has been claimed.

Two different lines of research will be followed in the next chapters. First, analysis will be conducted of the question of the benefit deriving from cooperation using a less simplified model in which explicit consideration is made of welfare effects and of the current account dynamics, and in which private and governmental intertemporal budged constraints are imposed. Secondly, a three country model will be used. This framework will allow analysis that cannot be pursued with a two country model and will enable us to address, among other things, the issue of coalition and of exchange rate arrangements.

3. A Model with current account dynamics and budget deficit

The main objective of this chapter is to reconsider the issue of desirability of international policy coordination within a context of a two-country model with micro-foundations, intertemporal budget constraints, wealth effects and current-account dynamics. An interesting feature of the following model is that it provides a consistent two-country model with micro foundations, whose short run properties correspond as closely as possible to the properties of the traditional two-country Mundell-Fleming analysis.[43]

As far as expectations formation is concerned, I will assume that while financial speculators have rational expectations, consumers/workers have naive ones. Both assumptions appear to be extreme, although quite standard. With this particular expectations mix, I will try not only to introduce a higher degree of realism, but, and mainly, to capture the different ways in which information is gathered and expectations are formed in financial and goods markets. More interestingly, this framework will enable us to avoid the case in which Ricardian equivalence holds, and to show that monetary and fiscal policy can have different effects on the exchange rate and on domestic variables, as well as different spill-over effects, according to the hypothesis on the way in which agents in the financial market expect intertemporal budget constraint to be satisfied.

3.1 Financial assets in an interdependent world

This section presents a two country Mundell-Fleming model, which has been extended to allow for sluggish wage-price dynamics and intertemporal budget constraints for the private sector, the government and the economy as a whole. The model can thus be seen as an extension of two-country real exchange rate overshooting models without wealth effects - e.g. Miller and Salmon (1985), Oudiz and Sachs (1985), Turnovsky (1986) and Van der Ploeg (1986) - which in turn extend the well known real exchange rate overshooting model of a small open economy - e.g. Dornbusch (1976), Buiter and Miller (1982) - and full-employment models of a small open economy with current-account

[43] Van der Klundert and Van der Ploeg (1989) work with a similar model. The main differences are that they assume perfect-foresight behaviour by the consumer and asymmetry in the degree of wage indexation in the two countries. We assume that consumers have naive behaviour, and I abstract from difference in the degree of wage indexation in order to focus on the role of expectations.

dynamics - e.g. Dornbusch and Fischer (1980). The model presented can also be viewed as an analytical version of the empirical multi-country model developed by McKibbin and Sachs (1986).

It is assumed that home and foreign goods are imperfect substitutes and that each country is wholly specialised in the production of its exportable good. The asset menu consists of home government bonds, foreign government bonds and home cash, so that there is no currency substitution or capital accumulation. Home and foreign government bonds are perfect substitutes. Labour is immobile, and nominal wages in each country are rigid in the short run. Financial speculators have rational expectations, but workers/households have naive expectations about future interest rates, taxes and income, and adaptive expectations about inflation. It is assumed that households expect future after-tax income and the interest rate to be equal to current after-tax income and the interest rate, respectively - which seems compatible with a sluggish adjustment of core inflation to CPI inflation. The resulting model is therefore a "story of smart speculators and naive workers". This is in sharp contrast with the story in which households have rational expectations when evaluating their human wealth (and naive expectations about expected inflation). In this case Ricardian debt neutrality holds, and current-account dynamics only play a trivial role. The repercussions of home policy on the rest of the world do not affect the home economy, and in this case the large-economy multipliers are the same as the small-economy multipliers (Van der Ploeg, 1989). This paper adopts a more Keynesian view and assumes that households have a myopic view of their human wealth. Alternatively, one could assume that a significant number of households in society are liquidity constrained.

The model is presented in the figure 3.1.1. Countries are symmetric: similar relationships hold for the foreign country. Foreign variables are denoted by an asterisk. M, D, F, W, C_D, C_M, C and e denote the per-capita aggregates for home holdings of real money balances, government debt, net foreign assets, denominated in domestic currency, and financial wealth, home consumption of home and foreign goods, total consumption and real exchange rate respectively. $\overline{G}$ and $\overline{T}$ denote the autonomous per-capita level of public spending on home goods and of per-capita lump-sum taxes. Y and $\overline{Y}$ denote the actual and full-employment per-capita level of output, π and π^t the actual and trend or core rate of inflation in production price, π^c the rate of inflation in consumption price, r and i the (growth-corrected) real and nominal rate of interest, and θ denotes the rate of growth in the nominal money supply.

Figure 3.1.1

3.1.1) $\dot{D} = rD + (\bar{G} - \gamma_G D) - (\bar{T} + \gamma_T D) - (\bar{\theta} + \gamma_\theta D)M, \quad D(0) = 0$

3.1.2) $\dot{F} = rF + Y - C_D - eC_M - (\bar{G} - \gamma_G D), \quad F(0) = 0$

3.1.3) $\dot{W} = rW + Y - (\bar{T} + \gamma_T D) - C, \quad W(0) = M_0$

3.1.4) $\pi = \phi(Y - \bar{Y}) + \pi^l$

3.1.5) $\dot{\pi}^l = \xi(\pi^C - \pi^l) = \xi\left[\pi + \alpha(\dot{e}/e) - \pi^l\right]$

$\Delta\pi^l(0) = \xi\alpha\Delta e(0)$

3.1.6) $E(\dot{e}/e) = r - r^* = i - \pi - i^* + \pi^*, \quad e(0)$ free

3.1.7) $C_D = \alpha_1 C, \; C_M = \alpha_2 C/e, \; M = \alpha_3 C/i, \; \alpha_i \geq 0, \; \sum_{i=1}^{3}\alpha_i = 1$

3.1.8) $C \equiv C_D + eC_M + iM = \vartheta_1(Y - \bar{T} - \gamma_T D) + \vartheta_2 W - \vartheta_3 r$

3.1.9) $Y = C_D + (\bar{G} - \gamma_G D) + C_M^*$

$W \equiv M + D + F$

Equation 3.2.2) shows that interest payments on external debt, or net receipts from external assets, plus the balance of trade are equal to the increase in the wealth of the nation. Net holdings of foreign assets are the excess of private sector agents holdings of bonds over government debt, that is F≡B-D. Equilibrium in the world bond market gives $B+eB^*=D+D^*$, which implies $F^*=-F/e$. Integration of 3.2.2.) and application of the country's solvency condition gives the country's intertemporal budget constraint:

3.2.2a) $-F(t) = eF^*(t) = \int_t^\infty \left[C_M^* - e(s)C_M(s)\right]\exp(-\int_t^s r(v)dv)ds$

which says that the current net foreign debt must be paid off by the discounted value of the stream of future surpluses in the balance of trade. In addition, we need a rule for where bonds are held initially: to simplify matters, it will assumed that initially neither country holds any foreign assets and therefore F(0)=0.

Equation (3.1.3) shows that saving gives rise to an accumulation of financial assets. Equation (3.1.4) is an augmented Phillips curve, where equation (3.1.5) shows that core inflation adapts sluggishly to CPI inflation. Under Cobb-Douglas preferences CPI inflation equals PPI inflation plus the share of imports in total expenditures, $\alpha=\alpha_2/(\alpha_1+\alpha_2)$, times the rate of depreciation of the real exchange rate. Equation (3.1.6) is the uncovered interest parity condition. Equation (3.1.7) shows how total consumption is divided between the demand for home goods, foreign goods and cash. There is

assumed to be a domestic bias in consumption ($\alpha_1 > \alpha_2$). The assumption of Cobb-Douglas preferences leads to unit elasticity of imports with respect to the real exchange rate and to unit semi-elasticity of money demand with respect to the nominal interest rate. Equation (3.1.8) gives the consumption-saving function. A rationale is provided, for example, by the aggregate life-cycle consumption function when there is a positive birth rate, due to either positive population growth, n, or a non zero probability of death, μ (e.g. Blanchard and Fischer, 1989, chapter 3; Buiter, 1988):

$$3.1.10)\quad C(t) = (\delta+\mu)\left\{W(t) + \int_t^{\infty}\left[Y_t^e(s) - T_t^e(s)\right]\exp\left[-\int_t^s (r_t^e(v)+n+\mu)dv\right]ds\right\}$$

where δ denotes the pure rate of time preference and the second term in the curly brackets denotes human wealth. The term Y_t^e denotes the expected value of Y(s) conditional on the information available at time t, and similarly for the other variables. The linearity of the consumption function arises from a unit elasticity of intertemporal substitution [44]. One can easily verify that a first order Taylor series expansion yields :

$$0 < \vartheta_1 \equiv \frac{\delta+\mu}{r(t)+n+\mu}\ ,\ \vartheta_2 \equiv \delta+\mu \text{ and } \vartheta_3 \equiv \frac{C(0)-(\delta+\mu)W(0)}{r(0)+n+\mu}$$

Equation (3.1.9) gives the condition for equilibrium in the home goods market. Finally, equations (3.1.1)-(3.1.3) and the wealth identity give the growth in the real money balances:

$$3.1.11)\quad \dot{M} = (\theta-\pi)M;\ M(0) = M_0$$

In the appendix of this chapter, impact multipliers for fiscal policy and steady-state multipliers which depends heavily on assets dynamics, are derived; in addition a number of policy experiments are described.

3.2. Optimal policy, debt financing and stability

Equation (3.1.1) describes the dynamics of the government debt, which will be explosive unless stabilising rules for taxes, seigniorage revenues and public spending are in force (e.g. if $\gamma_G + \gamma_T + \gamma_\theta M > r$). In other words, when the government debt gets out of hand, public spending is cut, total taxes are raised, and seigniorage revenues are raised. In the

44 A positive birth rate which drives a wedge between the discount rate used to calculate human wealth (see (12)) and the discount rate used to calculate government debt (see(10)) is one reason why Ricardian debt neutrality breaks down. An alternative reason is that households have fixed expectations ($r^e_t(s)=r(t)$, $Y^e_t(s)=Y(t)$, $T^e_t(s)=T(t)$).

absence of these stabilising rules, government debt is a predetermined, but forward-looking variable:

3.2.1) $D(t) = \int_t^{\infty} [\theta(s)M(s) + T(s) - G(s)] \exp(-\int_t^s r(v)dv)ds$

Ruling out Ponzi games enforces solvency and implies that the current government debt plus the discounted value of the stream of future public spending has to be financed by the discounted value of the stream of future taxes and seigniorage revenues [45].

In the policy analysis of this model, presented in the appendix to this chapter, I show that in order to ensure the dynamic stability of the model, two different assumptions must be made concerning the financing of the debt. A policy rule which gradually increases taxes or seigniorage, or decreases public expenditure, has been introduced in the model in order to avoid the explosion of debt. Alternatively, it is assumed that a future fiscal or monetary accommodation is required in the absence of a gradual policy rule.

Alternatively, if we abandon the hypothesis of a fixed policy rule to ensure debt convergence, we must assume that the policy-maker cares about the debt. In other words, the level of debt has must enter the loss function, and the weight given to it must be relatively high enough in order to obtain stability. The reason for that is easily understood: without an explicit consideration of debt in the loss function, no policy feedback between debt and policy instrument(s) will emerge. Let us consider here a simple loss function of the type:

3.2.3) $W = \frac{1}{2} e^{-\rho t} \int_t^{\infty} [\beta_1(\pi - \pi^d)^2 + \beta_2(y - y^d)^2 + \beta_3(D - D^d)^2] dt$

In order to obtain the dynamic stability of the model it is necessary to impose that β_3 is different from zero and sufficiently high. Note that, other things remaining equal, the minimum value of β_3 ensuring debt stability is an increasing function of the discount rate. A high discount rate creates the temptation to transfer the debt service towards the future, and if adequate weight is not given to the debt in the welfare function, it may easily follow an explosive path.

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45 An alternative to a feedback rule for stabilising the government debt is a structural adjustment. For example, a permanent increase in government spending can, given that θ=0, after a time τ, be financed by a permanent increase in taxes equal to $\Delta T = \Delta G \exp\left[\int_0^{\tau} r(s)ds\right] > \Delta G$.

3.3. Benefit of monetary and fiscal policy coordination

Before examining the desirability of international economic policy coordination in this new framework, it is advisable to underline the main differences between the present model and the model considered by Miller, Salmon and Sutherland. The two models are different in many respects. The most important, regards our present concerns, is the presence of the debt dynamics. Since we explicitly consider the intertemporal budget constraint, the main role of the public debt dynamic is to allow for a smoother time distribution of the policy response to initial shocks. This option was not available in the simple model presented in the previous chapters, and in that framework the best policy reaction would be the most rapid policy reaction. On the other hand, when it is possible to accumulate and decumulate the stock of public and foreign debt, a richer choice of possible time profiles of policy reactions is is available.

Given the size of the model, an analytical solution is not possible: as before, therefore, I perform numeric simulations. Table 3.3.1. gives the initial conditions and the parameter values used in the simulation:

Table 3.3.1

Initial conditions	r(0)=0.035	M(0)=9.93	$C_M(0)$=0.183	
Parameters	$\vartheta_1 = 0.76$	$\vartheta_1 = 0.76$	$\vartheta_1 = 0.76$	φ=0.10
	α_1 =0.45	α_2 =0.20	α_3 =0.35	ζ=0.10

3.3.1. Coordination of monetary policy

In this section I assume that the only available policy instrument is the rate of growth of money. In other words, this scenario can be interpreted as a situation in which the monetary authority settles monetary policy while fiscal policy is treated as fixed. It is assumed in particular that there is no fiscal authority which assumes responsibility for stabilizing public debt. Consequentely, the stability and the viability of the system hinge critically on the behaviour of the monetary authority. The inclusion of the term $(D-D^d)^2$ in the loss function 3.2.3) is therefore a simple way to capture two ideas. First, the amount of debt that government can accumulate is not unbounded. Second, the monetary authorities are aware of this fact.

In what follows I assume that the initial shock is analogous to that analysed by Miller and Salmon; that is, an increase in inflation determined by accumulated past

excess demand [46]. Table 3.3.2. summarises the main result; I have assumed that the weights given to the policy parameters are the following: $\beta_1 = 1$, $\beta_2 = 1$ and $\beta_3 = 0.007$. I claim that policy makers give the same weight to deviation of inflation and income from the equilibrium, while giving a smaller weight to debt stabilisation. With regard to the initial shocks, the case is considered in which the distribution of the shocks between countries is not symmetric: the domestic country faces a double inflation shock. ($Z(0)=2$ and $Z^*(0)= 1$). The table sets out the values of the reaction coefficients. With every kind of policies, the rate of growth of money tends to depend negatively on the accumulated past excess demand; however, the lack of adequate fiscal responsibility and the weight given to debt stabilisation in the loss function impose a positive relationship between the policy instrument and the level of public debt. However, the values of the reaction coefficients vary with the solutions adopted. The dimension and the sign of the reaction coefficients prompts an important consideration: the money growth rate will no longer be a monotonic function. The impact effect of the inflation shock is to induce a monetary contraction, but subsequently when inflation decreases and debt increases, monetary policy becomes expansionary.

Table 3.3.2.

	Reaction coefficients				Welfare losses	Gains from coordination
Time inconsistent	D	Z	D*	Z*		
Nash	0.130	-0.831	-0.002	-0.539	26.427	
Coop	0.129	-1.201	-0.147	-1.222	26.301	0.447%
Time consistent						
Nash	0.133	-0.775	-0.002	-0.479	26.550	
Coop	0.130	-1.203	-0.016	-1.112	26.403	0.554%

As before, the full optimal policy is time inconsistent: the difference between the time consistent and the full optimal policy, however, is not large. Figure 3.3.1 shows the path of the shadow price of the exchange rate: as regards the domestic country, the shadow price on exchange rate turns negative, after t=0, meaning that an increase in exchange rate will reduce welfare losses. Therefore, from the point of view of the domestic policy maker, the original plan in this first stage is too contractionary, since a currency depreciation will increase welfare. Moreover, after the first period, the shadow price turns positive meaning that in this second period a tighter monetary policy would

[46] In order to do this, added to the model is a new state variable $Z = \varphi(y - \bar{y})$ which enters the core inflation equation.

increase welfare. This behaviour appears more comprehensible when one inspects figure 3.3.2. which shows the path of the money growth under the time consistent solution. The upsurge of inflation calls for a monetary contraction; the monetary contraction, in turn, causes an accumulation of public debt that requires a monetary creation in order to raise the seigniorage revenue. Therefore, while in a first period the optimal policy requires a money contraction, in a second period monetary growth must expend in order to ensure debt stability. Similar considerations hold for the path of the exchange rate (figure 3.3.1.b.). In the short run, the exchange rate appreciates as a result of the monetary contraction: it causes an accumulation of foreign debt which leads in the long run to a depreciation of the real exchange rate in order to create the external deficit able to reduce the debt of the foreign country.

The particular time profile of the optimal policy has two important consequences. Time consistent solutions are characterised by smaller reaction coefficients: in this case, the optimal policy will be the result of the interplay between the activity of economic agents in forecasting the value of non-predetermined variable, accounting for the incentive of the policy-maker to renege and the activity of policy-makers to maximise welfare taking this private behaviour into account. Therefore the time consistent optimal policy will imply a lower initial money contraction and a less pronounced money creation thereafter: in other words, a smaller policy reaction. Secondly, it is evident that with such a time profile the bias induced by the lack of credibility of the policy maker will be not as conspicuous as it is in the Miller and Salmon model.

When these remarks are taken into account, the main result of the superiority of cooperation over decentralised policies, also in the case in which time consistent solutions are considered, becomes rather more comprehensible. From an economic point of view, it is the debt dynamics that engenders this result. Figure 3.3.3. which shows the behaviour of debt, evidences that a more pronounced use of the buffer role of public debt allows cooperative policy makers to force a sharper initial money contraction.

Important support for this idea is provided by figure 3.3.4., which shows that the gains from coordination tend to decrease with the increase in the weight given to the stabilisation of debt. The higher the weight on debt stabilisation, the less marked is the initial monetary contraction: therefore less gains can be extracted by coordinating monetary policies. Figure 3.3.5. and 3.3.6. show the behaviour of debt and money growth

when a weight of 0.07 is assigned to the debt stabilisation objective: clearly in this case less flexibility of debt clearly brings about less flexibility of money supply.

One of consequences of the assumption that fiscal authority does not assume responsibility for the stabilisation of public debt is the paradox known as *unpleasant monetarist arithmetic* [47]. Sargent and Wallace (1981) argue that a monetary contraction implemented in order to reduce inflation can yield the perverse result of an immediate increase in inflation. This result derives from the impossibility of coordinating fiscal and monetary policy and on the assumption that the fiscal authorities move "first" in the policy game. In this case, in fact, a decrease in the seigniorage induced by a decrease in the rate of growth of money cannot be compensated for by an increase in tax or by a decrease in public expenditure. It goes without saying that, in this case, a tight monetary policy now must involve a policy of loose money later, either via a gradual policy or via a future monetisation of the debt, in order prevent an explosive path of public debt [48]. Figures 3.3.7. and figure 3.3.8. show the path of core and consumer price inflation in the domestic economy under Nash policy. Since private agents expect a future monetisation of the debt, the disinflation policy has a perverse effect in the short run, as Sargent and Wallace suggest. Inflation, in fact, increases on impact and begins to decrease only after more than ten periods.

3.3.3.2 Monetary coordination with fiscal responsibility

In this section, I relax the hypothesis that the fiscal authority does not care about debt stabilisation. I distinguish two different cases. Firstly, we introduce a policy rule into the model which links tax level to the level of public debt ($T=\gamma D$), therefore setting $\beta_3=0$ in the loss function. In this case, it is assumed that the only aim of the fiscal authority is to stabilise the level of public debt, while the monetary authority is concerned with the stabilisation of real income and core inflation. Secondly, we assume that there is only one policy maker that can manage two different instruments, money supply and tax level, to stabilize all three targets. I am mainly interested in verifying whether the result in favour of cooperation is confirmed in the case in which the assumption of fiscal irresponsibility is relaxed.

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[47] See also the discussion in the appendix to this chapter in section 3.A.3.1.

[48] In Sargent and Wallace, however, the monetary authorities are assumed not to be aware that a bound on governmental debt exists. Therefore they act to reduce inflation today without considering the fact that this policy may cause more inflation in the future when that limit is close enough. I instead assume that the authorities internalise the constraint and consequently act from the very beginning of their planning horizon.

Table 3.3.3

	Reaction coefficients of monetary policy				Welfare losses	Gains from coordination
Tax rule (γ_T=0.15)	D	Z	D*	Z*		
Nash	0.067	-16.81	0.041	7.674	8.8122	
Coop	0.084	-14.31	0.067	1.495	8.3504	5.240%
Tax and monetary policy						
Nash	0.138	-1.413	0.002	1.053	1.611	
Coop	0.138	-1.399	0.002	1.039	1.606	0.317%

Table 3.3.3 summarises the main results. In order to simplify the presentation, it is restricted to time consistent solutions.

With a sufficiently high value of γ, the stability of public debt is ensured. In this case, quite obviously, the reaction coefficient on debt will be lower than in the case in which monetary policy has to ensure debt stability. The positive relation between money supply and debt along the optimal path, still present in this case, is due to the fact thatthe money supply has to increase to reduce the deflationary effect of tax increase [49]. It is evident, on the other hand, that the reaction coefficients on the Z, the inflation displacement, is now far higher than in the case in which fiscal irresponsibility was assumed. As far as the main point of our inquiry is concerned, also in this case the superiority of the coordinated response is obtained. As a matter of fact, gains from coordination are now higher than before. As before, however, the gains from coordination tend to decrease with the increase in the value of γ_T. Finally, one observes that the welfare costs, both under Nash and cooperative solutions, are lower than when fiscal responsibility was assumed. This result admits to two different explanations: first, there are now two instruments available for the same initial shock; second, the deviation of the debt variable from equilibrium is no longer computed as a welfare cost.

The last rows of the table 3.3.3. report the reaction coefficients and the welfare outcomes when it is assumed that the policy authority has two instruments available: both monetary policy and tax policy. Welfare losses in this case are far lower than before: there are now two instruments available for the optimal policy. Also in this case, the cooperative policy yields a better outcome by allowing a less reactive policy reaction by both countries. It is worth observing that the monetary reactions on Z are now lower than before because a antinflationary role is played by the tax instrument as well.

[49] It is worth noting that when the value of γ_T is high enough this indirect effect is rather important and the reaction coefficient may be higher than in the case of fiscal irresponsibility.

I observe in conclusion to this section that the result of benefits accruing from coordination does not depend on the hypothesis of a lack of fiscal responsibility on the part of the fiscal authorities.

3.3.3.3. The productivity of coordination

In previous sections I have shown that cooperation pays even if initial shocks are asymmetrically distributed and time consistent policies are considered. It is therefore of interest to analyze the reason for this result. Note first that the bias induced by the lack of credibility of policy makers appears more substantial in the case of Nash policy than in the cooperative case, as testified also by the finding that gains from coordination are higher when time consistent policy is considered. As a matter of fact, the bias induced by the lack of credibility can be measured at 0.46% in the case of Nash policy and at 0.38% in the case of the cooperative solution. This result is in contradiction with Rogoff result. In his model, as in that by Miller and Salmon, policy makers have the incentive to inflate in order to reduce unemployment. While in the non cooperative equilibrium this incentive is restrained by its effect on the exchange rate - the exchange rate will depreciate and inflation will increase - in the cooperative equilibrium the exchange rate is unaffected so that each policy maker has a greater incentive to inflate. Rational and forward looking private agents will foresee this higher incentive, and therefore the inflation bias will be greater under cooperation. When considering time consistent solutions, the higher credibility bias will imply a more lethargic policy response under cooperation which will lead to higher welfare losses.

In the model presented in this section, on the contrary, the path of exchange rate is not longer monotonic. It must initially appreciate in response to the initial monetary contraction. The appreciation in turn creates an accumulation of external debt. Therefore in the longer run the exchange rate must depreciate in order to create a current account surplus able to repay the accumulated external debt. It is likely that the a coordinated response will reduce the extent of the necessary depreciation in the long run which reduces the incentive to renege on the announced policy in the long run. In other words, the incentive to renege, and therefore the bias deriving from the lack of cooperation, displays a form of path dependence: the internalisation of policy externalities arising under cooperation will reduce the credibility bias in the long run.

Not surprisingly, therefore, this result does not depend on the distribution of initial shocks; gains from coordination decrease very slightly when initial shocks become more and more asymmetrically distributed.

3.4 Coordination of fiscal policy

In this last section, the issue of fiscal policy coordination is analyzed. This issue has not received as much attention in the literature as the associated question of monetary coordination. This can be justified on the grounds that the determination of fiscal policy is a more complex process; it is often argued that it already requires the cooperation of more than one domestic institution, for example both government and parliament. On the other hand, the issue has recently gained in more importance because there are numerous countries with problems of debt stability, but also because the problem of fiscal coordination and of fiscal federalism has been posed and analysed within the context of designing a European monetary union.

In what follows I ignore all the above-cited difficulties in determining the fiscal stance and focus on the existence of gains from cooperation when considering fiscal policy. There are two main channels of international trasmission of fiscal policy: one is changes in the terms of trade; the other is in the net tax return available to international mobile capital in different localities (Frenkel and Razin, 1987 and Frenkel, Razin and Sadka, 1991 contain a complete theoretical discussion of both issue respectively). In this section, however, I concentrate on the second channel since the model I employed is not suitable to study the first channel of interdependence [50].

I assume that the policy makers have two different instruments: tax level and government expenditure, and three targets: the stabilisation of real income and core inflation and the stabilisation of debt according to the loss function 3.2.3. In this instance, it appears more interesting to treat the case in which our countries display an outstanding level of public debt, although the stock of debt is not symmetrically distributed and the domestic country is far more indebted than the foreign one [51]. We will compute the optimal policy response to this initial shock.

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[50] A survey of tax competition and cooperation can be found in Persson and Tabellini, 1995

[51] In particular I assume that the initial value of the real debt is 10 in the domestic economy and 3 in foreign economy.

Table 3.4.1.

	Reaction coefficients								Welfare losses	Gains from Coop
	tax instrument				expenditure instrument					
	D	Z	D*	Z*	D	Z	D*	Z*		
Full optimal policy										
Nash	0.658	-0.803	0.037	-0.600	0.150	-1.923	0.096	-1.000	1.472	
Coop	0.693	-0.795	-0.050	-0.549	0.142	-1.890	0.083	-1.013	1.4661	0.402%
Time consistent										
Nash	0.654	-0.774	0.037	-0.590	0.148	-1.891	0.095	-1.012	1.473	
Coop	0.690	-0.786	-0.046	-0.559	0.141	-1.887	0.085	-1.016	1.4662	0.464%

Table 3.4.1 summarises the main results. The first thing that warrants attention is that the difference between full optimal and time consistent policy is very slight. Figure 3.4.1. shows the path of the shadow price on exchange rate. The domestic policy maker playing Nash would find it useful to induce a exchange rate depreciation, somewhat reducing the tax increase in the short run; successively, however, a long lasting, although moderate, incentive for an appreciation emerges. The net effect is likely to be small. Figure 3.4.2 compares the path of shadow price in the case of fiscal and monetary policy: in the case of fiscal policy the incentive to renege is lower than in the case of the monetary policy

The analysis of the reaction coefficients prompts some interesting remarks. The optimal assignment of instruments to targets would seem to be that of assigning the tax level to control debt accumulation and public expenditure to control the real income and, partially, the core inflation. This result is not surprising since it confirms the conventional view of economic policy theory: in assigning instruments to targets, each instrument should be assigned to the target which it will more powerfully affect. Figure 3.4.3. shows the path of domestic debt when different policy instruments - tax increase, expenditure decrease and money creation - are used; it is evident that the tax policy is much more effective in stabilising debt than public expenditure and money creation. Also the explanation of the superiority of the cooperative solution can be understood by looking at the reaction coefficients: coordination allows a more powerful use of the tax increase in order to reduce debt more rapidly and of expenditure reduction in order to control core inflation. Figure 3.4.4 shows the path of tax and expenditure in the case of Nash solution: both jump upward in order to reduce debt without destabilizing output and core inflation. Soon afterwards, both start to decrease; in the long run approach zero from the negative quadrant in order to create a moderate public deficit able to absorb the

governmental surplus created by the short run policy. The paths of domestic real income and core inflation are shown in figure 3.4.5 and figure 3.4.6. This two figures accredit the result of the superiority of cooperation: in this case, in fact, domestic real income and core inflation are closer to their equilibrium values.

3.5. Concluding remarks

In this chapter I have analyzed the issue of the desirability of cooperation when considering a more sophisticated and richer model: the principal innovation is the explicit consideration of the external and governmental budged constraints. These constraints determine in turn a less simplistic design of the optimal policies. In this framework I have shown that the inflation bias induced by the lack of reputation of the policy maker may be greater under non cooperative equilibrium than under cooperative equilibrium.

Undeniably, however, one of the mayor weaknesses of our analysis is the fact that we have used a specific, although rather standard, model which has been solved with the help of numerical simulation. Therefore, although a general rejection of the Rogoff paradox cannot be justified, it seems to me that a more careful attention should be posed to the analysis of cooperation using the time consistent policies in a context in which intertemporal budget constraints play an important role.

Figure 3.3.1

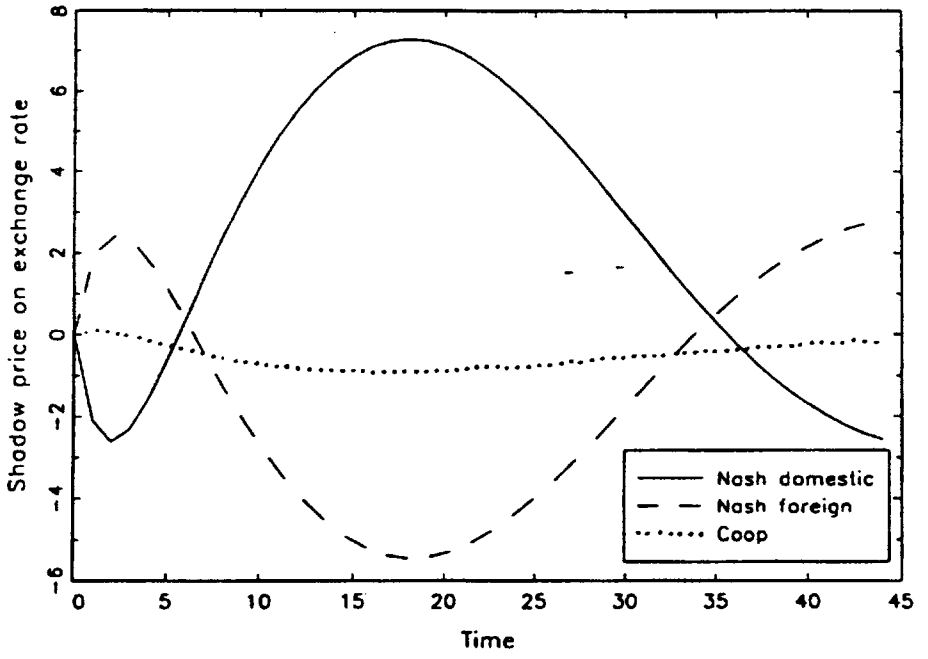


Figure 3.3.2

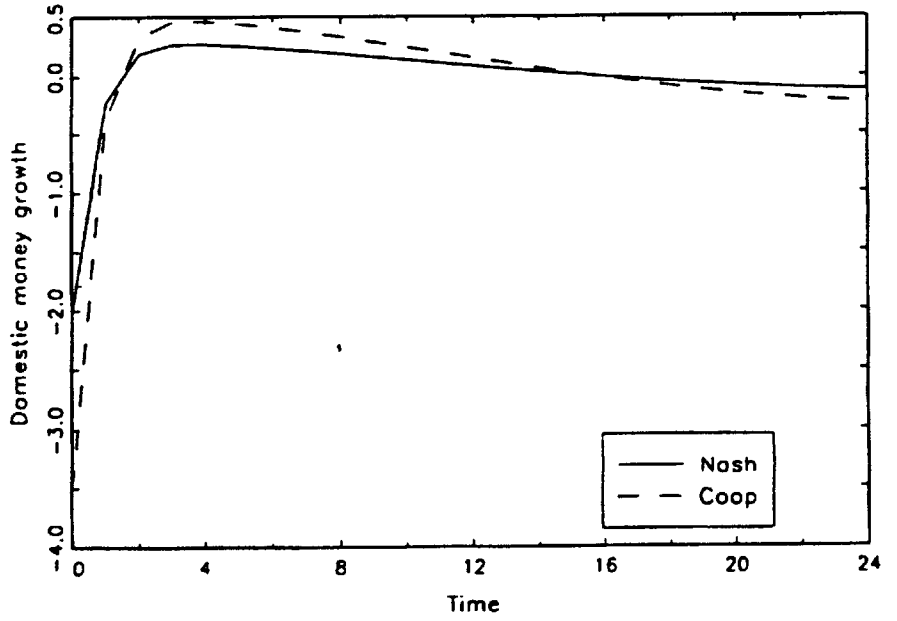


Figure 3.3.3

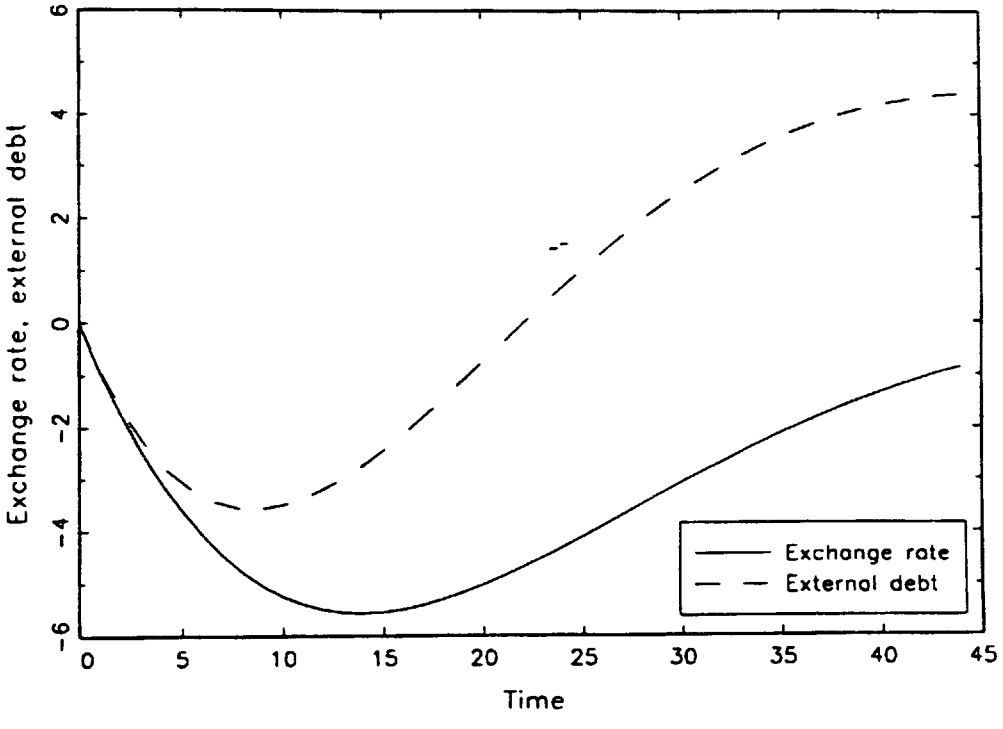


Figure 3.3.4

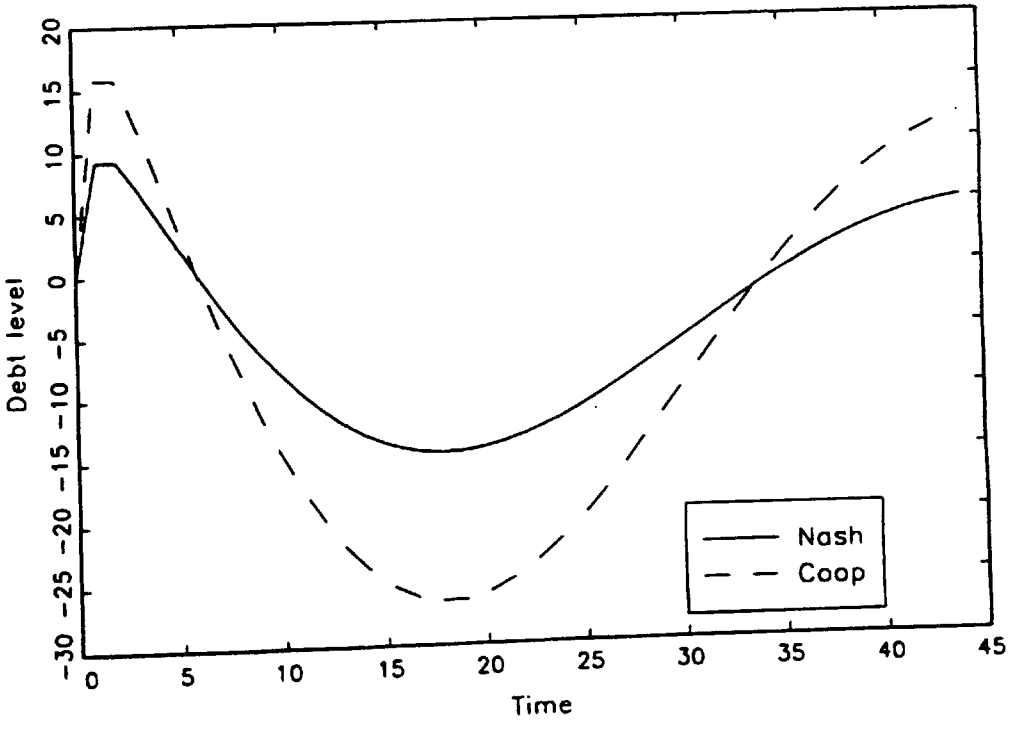


Figure 3.3.5

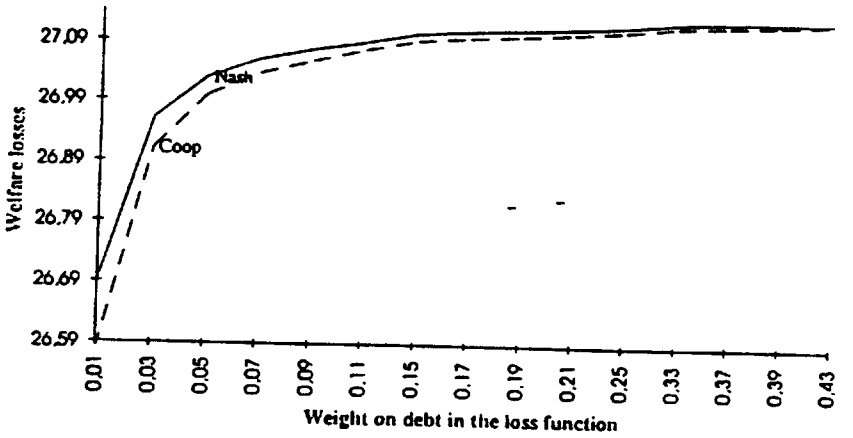


Figure 3.3.6

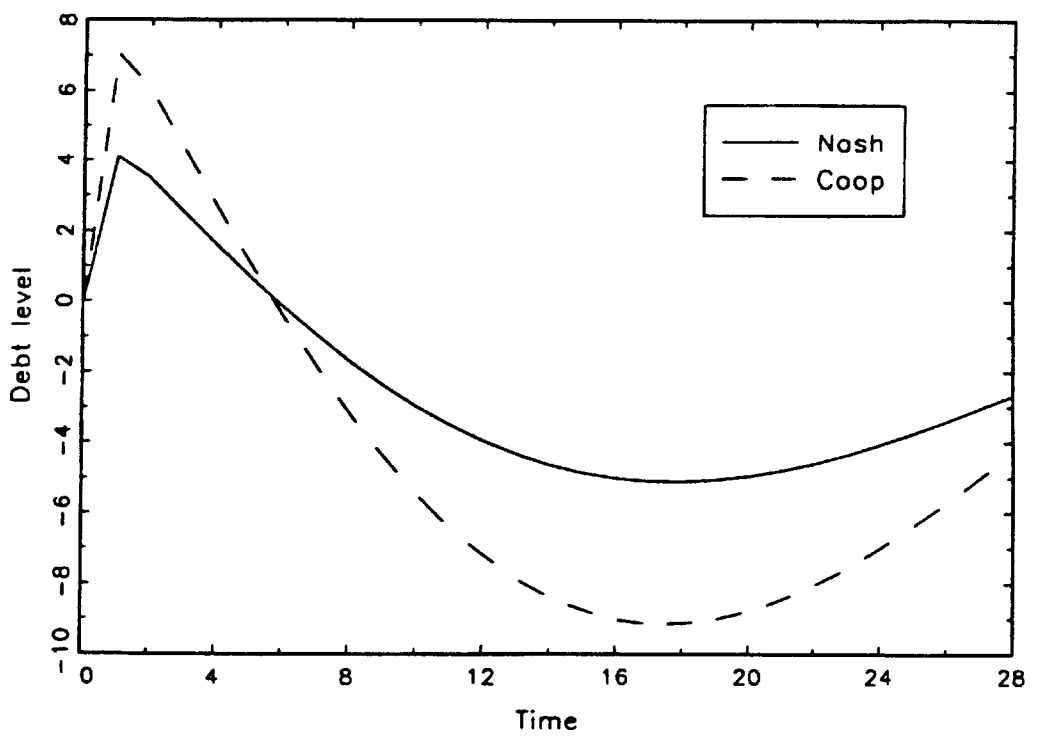


Figure 3.3.7

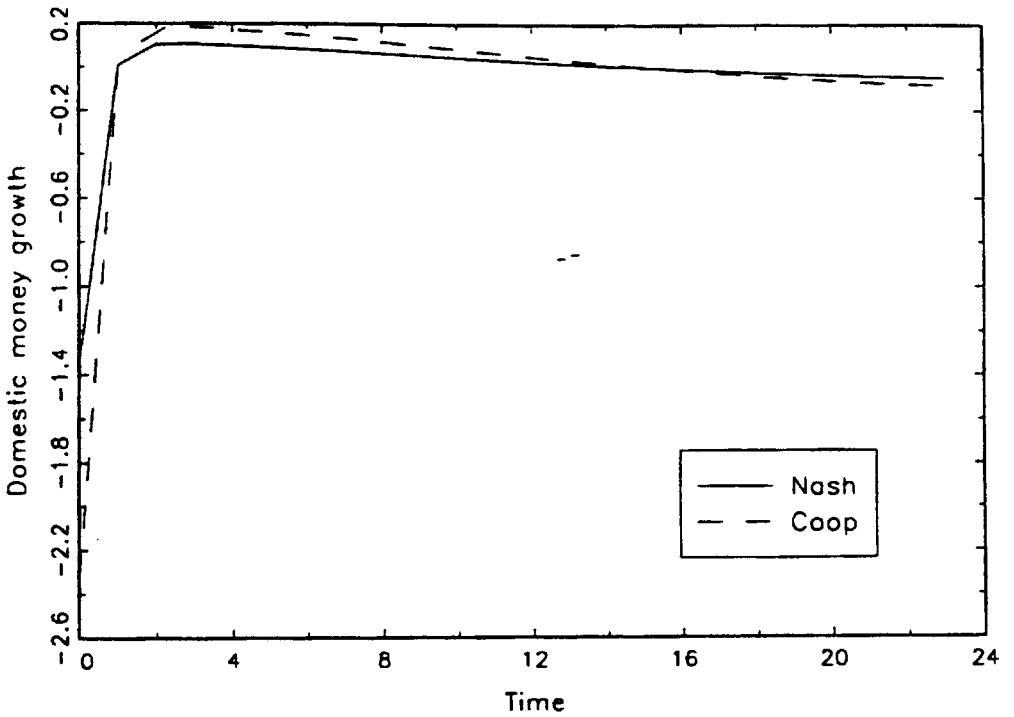


Figure 3.3.8

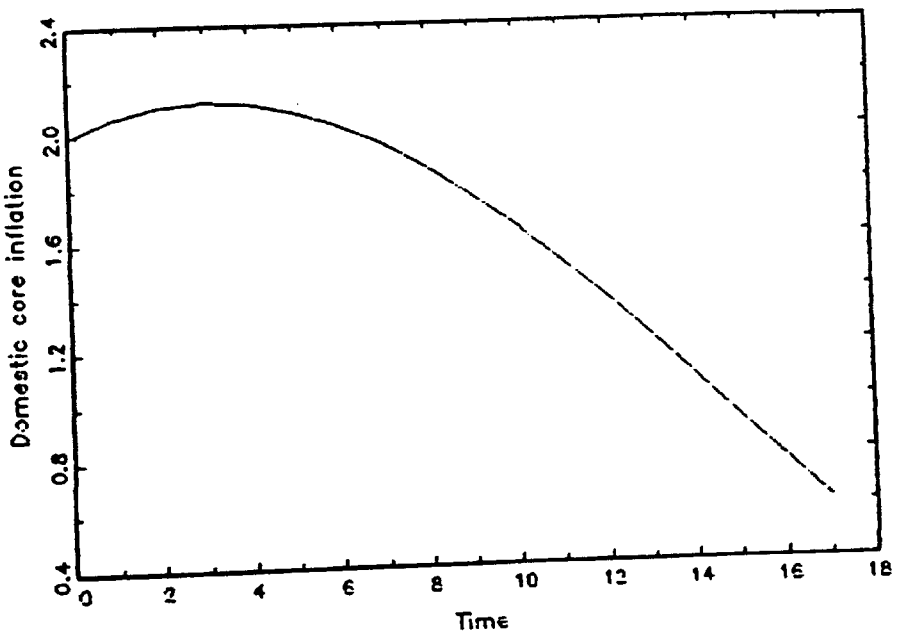


Figure 3.3.9

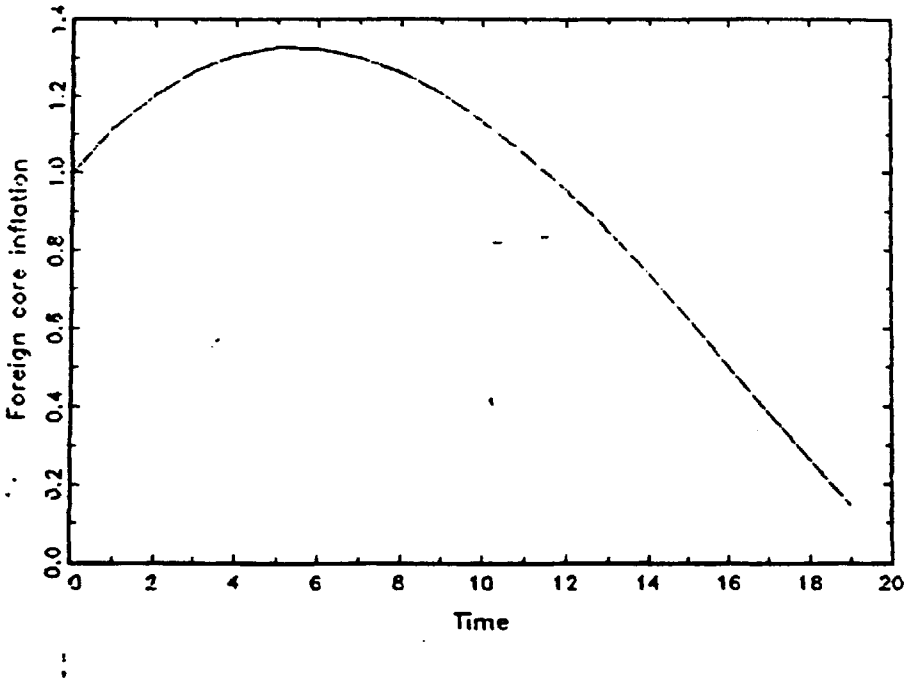


Figure 3.4.1

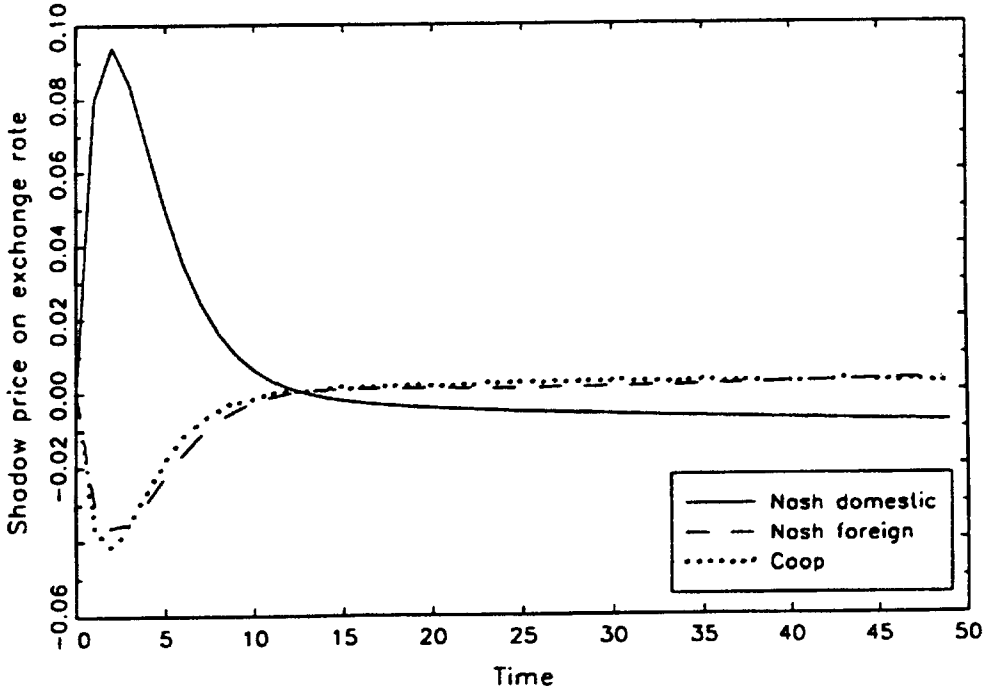


Figure 3.4.2

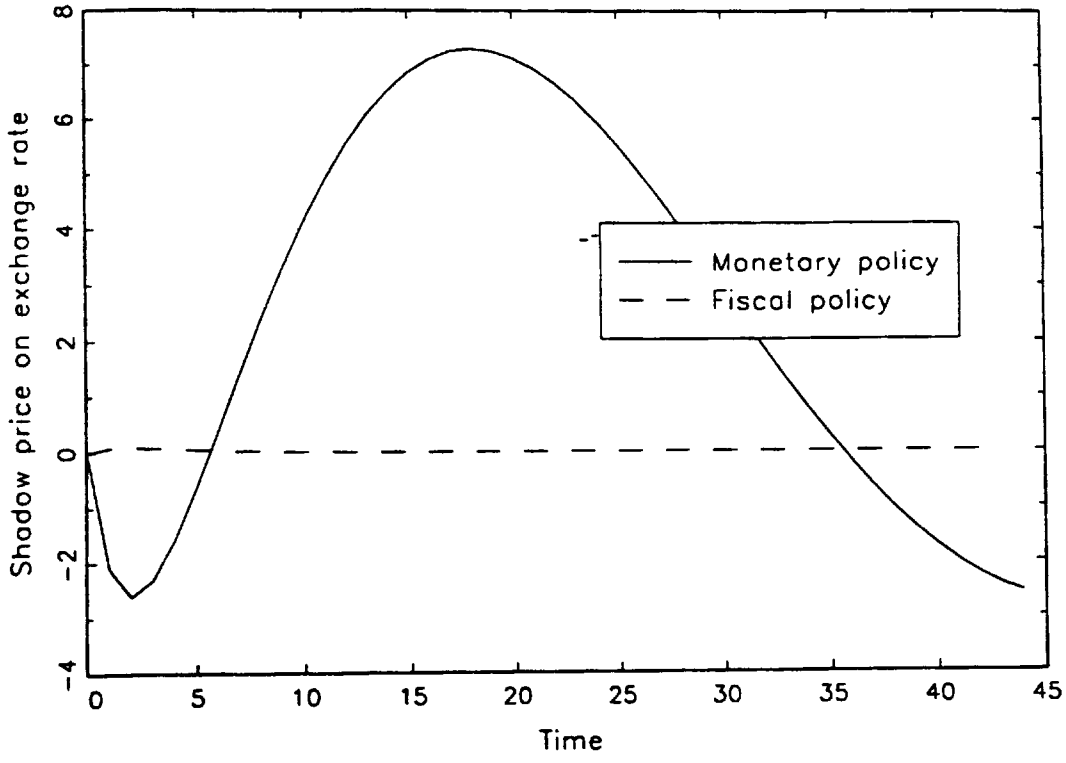


Figure 3.4.3

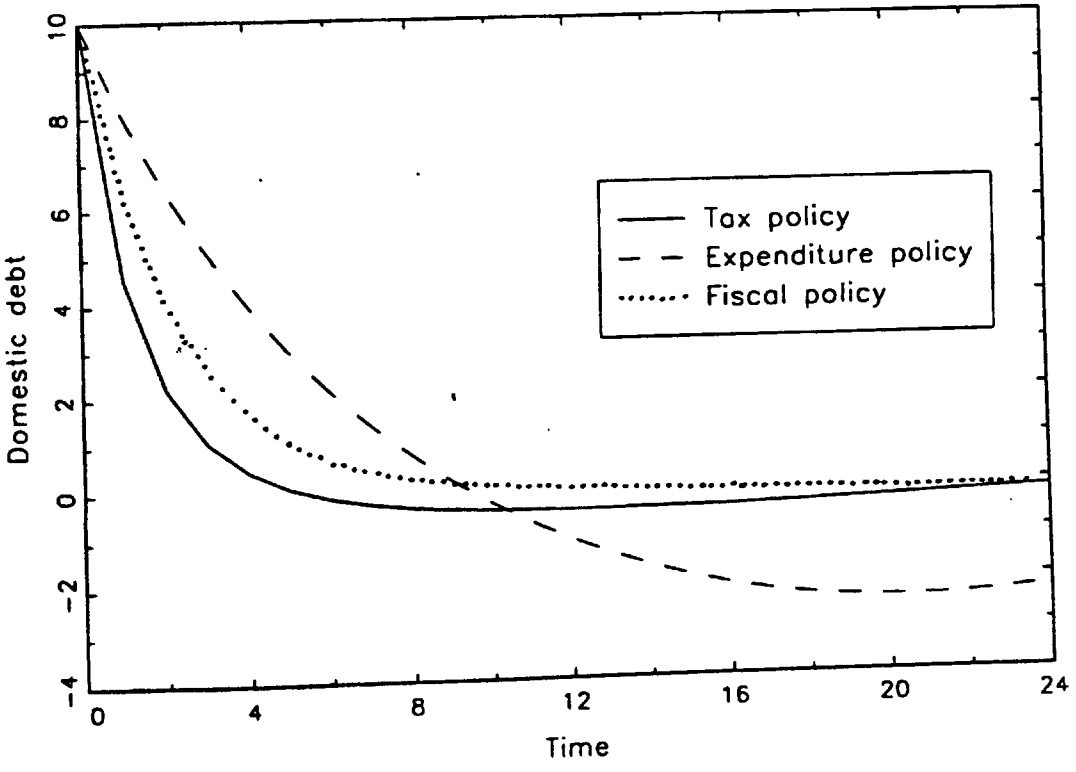


Figure 3.4.4

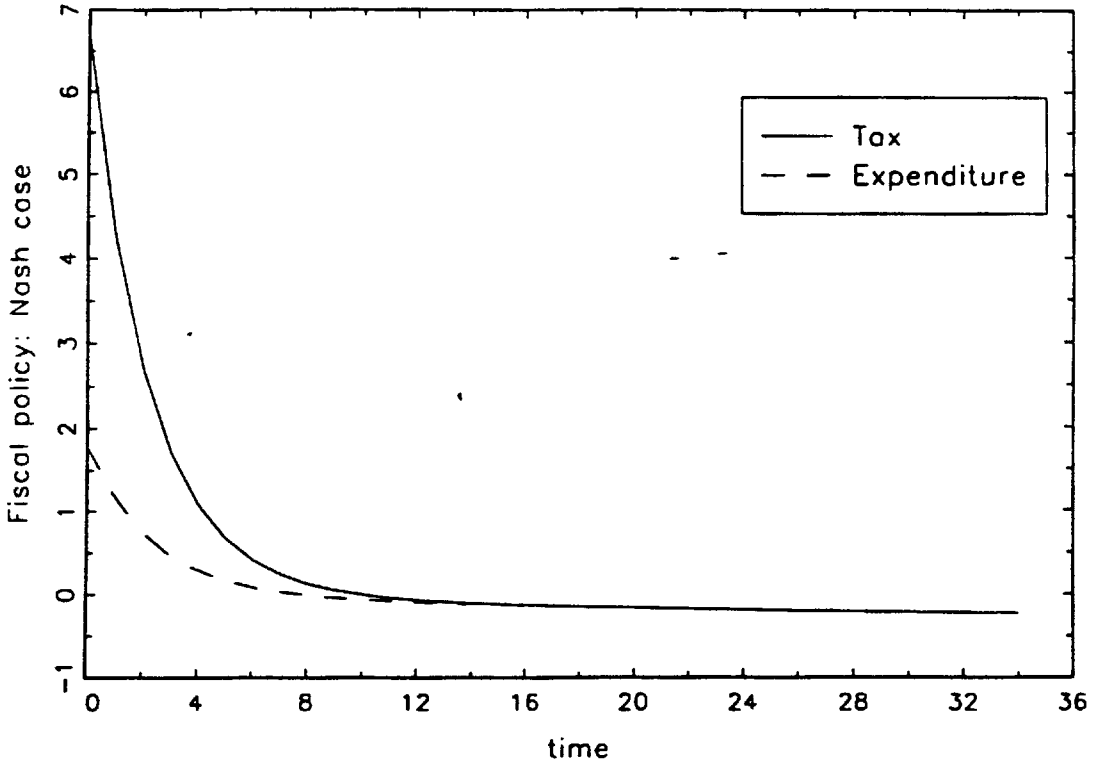


Figure 3.4.5

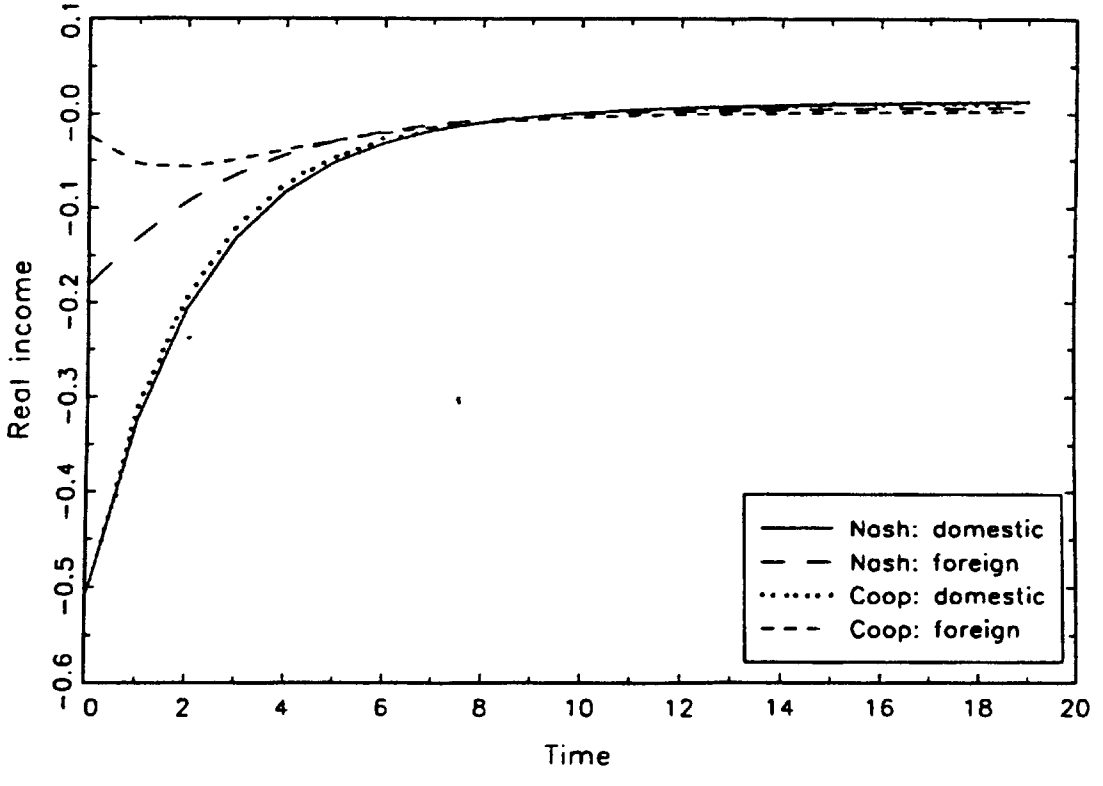
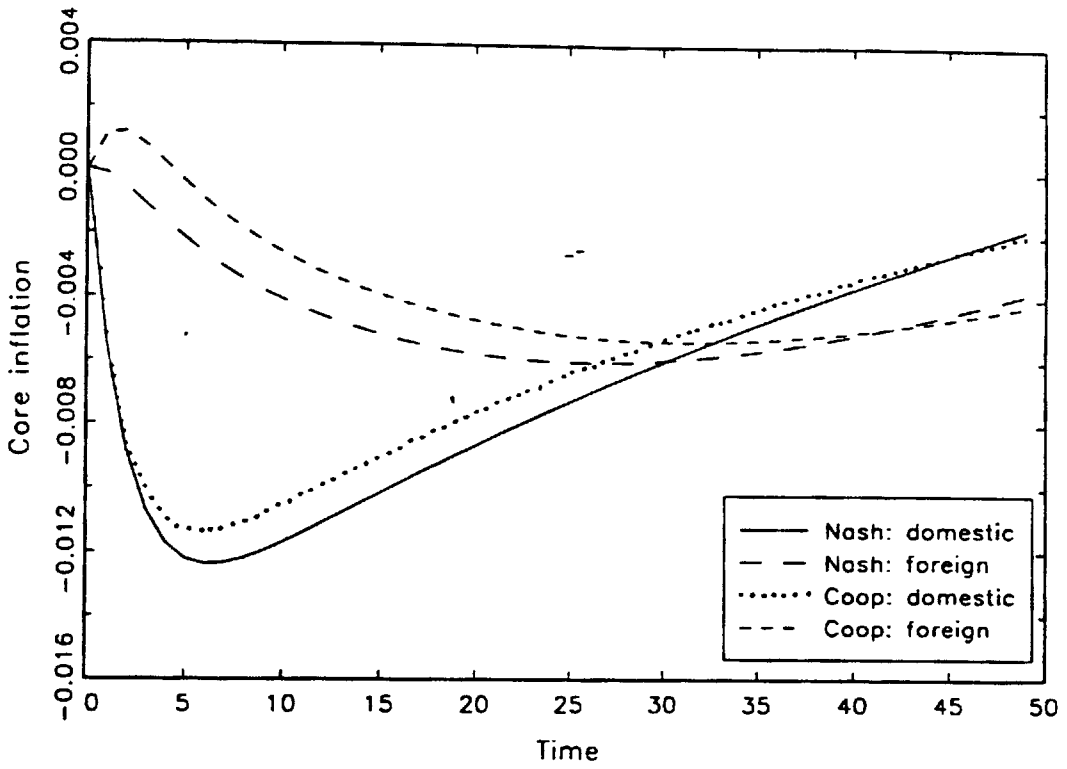


Figure 3.4.6


Core inflation
0.004
0.000
-0.004
-0.008
-0.012
-0.016
0
5
10
15
20
25
30
35
40
45
50
Time
Nash: domestic
Nash: foreign
Coop: domestic
Coop: foreign

3.A Appendix

3.A.1 Impact multipliers for fiscal policy

This section considers the implementation effects of changes in fiscal policy. These implementation multipliers ignore the announcement or "news" effects arising from initial jumps in the real exchange rate [52].

For the sake of brevity, we I will not present here all the implementation multipliers in detail [53]. Interestingly enough, most of them correspond to the standard Mundell-Fleming multipliers. We will instead concentrate on the two of them that appear most interesting.

An increase in government spending is a locomotive policy

$$3.A.1)\quad \frac{dY^*}{d\bar{G}} = \frac{1}{2}\left(\frac{1}{\Delta^a} - \frac{1}{\Delta^d}\right) > 0$$

where:

$$\Delta^a \equiv 1 - (\alpha_1 + \alpha_2)\vartheta_1 + \frac{[(\alpha_3\vartheta_1 / M) - \phi](\alpha_1 + \alpha_2)\vartheta_3}{1 + \alpha_3\vartheta_3 / M}$$

and

$$\Delta^d \equiv 1 - (\alpha_1 - \alpha_2)\vartheta_1 + \frac{[(\alpha_3\vartheta_1 / M) - \phi](\alpha_1 - \alpha_2)\vartheta_3}{1 + \alpha_3\vartheta_3 / M} > \Delta^a$$

This is quite distinct from the traditional Mundell-Fleming result, because the implementation effects do not take account of changes in the exchange rate. If the LM-curve slopes upwards, fiscal expansion induces an immediate expectation of a depreciation of the real exchange rate ($\frac{dr^d}{d\bar{G}} > 0$). The appreciation of the exchange rate associated with the "news" effect occurring on impact further reinforces, through the increase in net imports, the locomotive aspects of fiscal expansion.

Finally, the "news" effects of an initial jump iin the real exchange rate are

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[52] It is convenient to solve the linearized short run IS-LM framework for Y and r in terms of $\bar{G}, \bar{T}$, and e(0), given D, F and M, in terms of global averages and differences (cf., Aoki, 1981).

[53] These can be found in a longer and previous version of the this paper; see Bosco (1991b).

$$3.A.2.)\quad \frac{dY^d}{de(0)} = 2\frac{C_M + \xi\alpha(\alpha_1 - \alpha_2)\vartheta_3[1 + \alpha_3\vartheta_3 / M]^{-1}}{\Delta^d} > 0$$

$$3.A.3.)\quad \frac{dr^d}{de(0)} = 2\frac{[\alpha_3\vartheta_1 / M - \varphi]C_M + [(\alpha_1 - \alpha_2)\vartheta_1 - 1]\alpha\xi}{(1 + \alpha_3\vartheta_3 / M)\Delta^d} > 0$$

Equation 3.A.2.) shows that the jump (an appreciation) in the real exchange rate reinforces the locomotive effect, but reduces the own multiplier effect of a fiscal expansion: i.e. it channels part of the expansion effect towards the foreign country. Equation 3.A.3.) is interesting, because it shows that overshooting of the real exchange rate is no longer the necessary consequence of a monetary disinflation. In other words, even if an interest rate differential in favour of the home country corresponds to the expected depreciation of the real exchange rate, the real exchange rate will depreciate (rather than appreciate) on impact when $(\frac{de(0)}{d\bar{G}} > 0)$ is positive (negative). This does not occur in more ad-hoc open-economy models (e.g. Buiter and Miller, 1982).

3.A.2 Steady-state multipliers for fiscal and monetary policy

In the long-run, output is at its full-employment level, inflation is determined by monetary growth and real interest rates are equalized throughout the world. The long-run multipliers evaluated around a zero inflation, zero debt, symmetric steady state can be easily found. We present here an intuitive graphical analysis (see figures 3.A.1 and 3.A.2).

The upper right quadrant of the figure shows the goods market equilibrium conditions for both countries. In the case of domestic economy (GME locus) it is downward sloping because a depreciation of the real exchange rate boosts foreign demand for home goods, and the resulting excess of demand for home goods is to be choked off by a fall in the world real rate of interest. The opposite is the case of the foreign economy (GME* locus). The upper left quadrant gives the relation (WW locus) showing that the real wealth depends positively - coeteris paribus - on the real rate of interest. In the lower quadrant the locus CC is drawn. The total real consumption, other things remaining constant, is correlated positively with real wealth. Since countries are perfectly symmetric, these latter relations are the same for both economies. It is worth noting that all the relations also depend on the tax level: i.e. a change in the tax level will cause a shift in the curves.

The simplest case to analyse is that when a fiscal expansion is financed with an increase in seigniorage (figure 3.A.1). This shifts the GME locus to the left, while the other curves are not affected, so that the real exchange rate appreciates and the real interest falls. The result is a symmetric fall in home and foreign wealth and, typically, private consumption. Since foreign expenditure on domestic goods also falls, while foreign export must increase, there will be a foreign trade surplus and thus a home trade deficit so there is less than 100% crowding out of private consumption. It follows that there must be an accumulation of net foreign assets in order to finance the steady state trade deficit.

In the case where a balanced-budget fiscal expansion (see figure 3.A.2) is considered, the question is less straightforward, since all curves shift with changes in taxes. GME shifts towards the left, but obviously less than in the previous case, but now also GME* shifts towards the right. Given our assumption about the preference for own goods i.e. $\alpha_1 > \alpha_2$, the net effect will be an appreciation of the real exchange rate and a fall in the real interest rate although to a lesser extent than in the case where the increase in government spending is financed with money. The effect on wealth and consumption will no longer be symmetric because now the domestic curves describing wealth and consumption equilibrium will shift as shown in figure 3.A.2, while the foreign ones will not change. That means a greater steady-state reduction in consumption for the domestic economy, while foreign consumption decreases less than in the former case.

Finally, it is worth noticing that, as is quite common in this kind of model, monetary policy has no real effects in the long run. The only effect will be to a redistribution in the composition of real wealth: a higher level of the money stock and a lower level of domestic debt.

3.A.3. Policy experiments

Table 3.A.1. shows the value of the parameters and the initial conditions used in the numerical simulations. The package used to run these simulations was the PSREM developed by Markink and Van der Ploeg (1989). The eigenvalues evaluated at steady state are also present in table 3.A.1. It is evident that the saddlepoint property is satisfied, since we have just one forward looking variable in our model, i.e. the real exchange rate.

Table 3.A.1

Initial conditions	r(0)=0.035	M(0)=9.93	$C_M(0)$=0.183	
Parameters	$\vartheta_1 = 0.76$	$\vartheta_1 = 0.76$	$\vartheta_1 = 0.76$	α_1 =0.45
	α_2 =0.20	α_3 =0.35	φ=0.10	ζ=0.10
initial values	r(0)=0.035	M(0)=9.93	$C_M(0)$=0.183	
Real part of eigenvalues	-0.065	-0.065	-0.057	-0.057
	-0.032	-0.032	-0.018	0.035

3.A.3.1. Monetary disinflation and unpleasant monetarist arithmetic

Sargent and Wallace (1981) argue that a monetary contraction implemented in order to reduce inflation, can yield the perverse result of an immediate increase in inflation. In this section we analyse the effect of a policy of monetary disinflation. First of all we examine the effect of a monetary contraction in the case where the announcement of a future fiscal adjustment is believed by the private agents. Then we turn to examine the case where agents forecast a future monetisation of the debt and evaluate the Sargent-Wallace argument.

Table 3.A.2a. shows the first scenario. A 10% decrease in the rate of growth of money is financed by a tax increase after twenty periods [54]. A strong real appreciation of the domestic currency is obtained. This brings about a sharp redistribution of world demand in favour of the foreign country: domestic income and domestic consumption significantly fall while foreign income and foreign consumption increase. In the long-run, a real depreciation of the domestic currency is necessary to restore equilibrium in the goods market: a decrease in after-tax income entails an increase in export. Income and consumption in the domestic economy start increasing after the initial fall. But they fall sharply again when the fiscal adjustment comes into play. The disinflation measure is effective since the consumers' price significantly falls on impact. Then it increases until the moment at which the fiscal contraction takes places.

Table 3.A.2b concerns the case where a future fiscal adjustment is not credible, even if preannounced. Private agents expect a future monetisation of the accumulated debt. Note that a completely similar policy measure, i.e. a money contraction of 10%, has now completely different effects. First of all the own and spill-over effects are now generally smaller than before. This is due to the fact that only the timing i.e. the distribution over time, of the monetary policy has changed. Nevertheless, we may

54 From eq(10) we obtain that $\Delta T(20) = -\exp\left[\int_0^{20} r(s)ds\right]\Delta\theta(0)M(0)$

conclude that in this model monetary policy is effective in the short-run even in its mildest form of a postponement of money creation. A significant appreciation of the domestic currency is substituted by a light depreciation of the currency. Private agents, in fact, discount a future increase in money creation. This causes a redistribution of the world demand in favour of the domestic economy: domestic income and domestic consumption increase while the consumption and income of the foreign country decrease. This is just the impact effect, however. Income and consumption start soon to decrease in both countries, although to a lesser extent than in the former case. The disinflation policy has perverse effects, as Sargent and Wallace suggest. Consumer prices, in fact, increase on impact and continue increasing up to the long run value. A higher steady state rate of inflation is the only long-run effect of such a policy along with a redistribution of wealth between the stock of debt and the real stock of money.

3.A.3.2. A decrease in taxation

Table 3.A.3a shows the effects of a cut in the domestic tax receipts when a policy rule "a' la Reagan" is used to stabilize the growth of the domestic debt, i.e. the tax cut precedes the reduction in government expenditure. The impact effects are those expected. The increase in after-tax income boosts domestic consumption. This short-run effect is positively, although less powerfully, transmitted to the foreign economy. Domestic and foreign inflation increase. A slight real depreciation of the domestic currency takes place. Domestic debt starts to accumulate, since the initial measure causes a budget deficit. This brings about a gradual reduction in government spending caused by the policy rule adopted to stabilize debt. Despite the initial depreciation of the currency, the initial positive income effect leads to a deficit on the current account followed by an increase in the foreign debt.

The long-run effect of this policy will be to induce a long term increase of consumption, although much of this increase has been brought about by a greater consumption of money balances caused by a higher real exchange rate. As far as goods consumption is concerned, the consumption of domestic goods increases at the expense of foreign goods. The new steady state level of the foreign debt shows that the foreign economy becomes a rentier economy, in the sense that it benefits from the initial cut in taxes. A final depreciation is needed in order to determine a current account surplus able to pay the interest on the foreign debt stock.

Table 3.A.3b shows the case where the same initial cut in the tax receipts comes along with a policy rule that links the increase in debt with the increase in taxes. The

impact effect is very similar to the previous case. Soon after the dynamic pattern appears to be significantly different, apart from the dynamic path of domestic debt, which is independent of the rule used. The positive effect on real income last more periods than in the case where a rule on government spending is used.

The effect on consumption is more interesting. Since the burden of debt stabilization is now on taxes, the gradual increase in taxation brings about a gradual reduction of consumption. It is worth noting that this causes a less significant deterioration in the current account of the balance of payments. In this second scenario, then, the accumulation of foreign debt is significantly less, and, consequently, a less final depreciation of the real exchange rate is needed. The transfer of wealth in favour of the foreign country is much less significant in size than in the previous case.

3.A.3.3 A fiscal expansion

As is well known, the effect of an increase of public spending depends crucially on the way in which such an increase is financed (Buiter, 1986) [55]. In this section we will show that the effect of an increase in public spending financed by issuing government debt, can be very different both on impact and in the long run, according to the way in which private agents expect the policy-maker to stabilize the debt. We will compare two different scenarios: in the first we assume that private agents believe that the growing debt will be stabilized in the future by a fiscal adjustment - an increase in taxation; in the second we will assume that private agents expect the debt to be monetized in the future [56]. The effect of the same initial measure is dramatically different in the two cases.

Table 3.A.4a (fiscal adjustment) and table 3.A.4b (monetary adjustment) depict the two different scenarios. In both cases domestic income and consumption increase on impact along with the inflation rate. The completely different behaviour of the real exchange rate on impact brings about a different transmission of the impact effect to the foreign country. In the former case the expectation of a fiscal adjustment determines a real appreciation of the domestic currency that, in turn, directs part of the increase in the world demand towards foreign goods; in the latter case the expectation of an increase in

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55 An increase in the provision of public goods can be financed in three different ways: by a current increase of taxation - balanced budget fiscal expansion -, by an increase in the rate of growth of money - i.e. by seigniorage -, or by public debt. In this latter case, however, in a model in which the intertemporal budget constraints of the government and of the private sector is explicitly taken into account, a policy rule that stabilizes the debt has to be introduced.

56 A complete discussion of the effects of a fiscal expansion in this kind of model can be found in Bosco, (1991a).

the rate of money creation causes a depreciation of the domestic currency, leading to the beggar-thy-neighbour effect of a domestic fiscal expansion [57].

As far as the dynamic effects are concerned, it goes without saying that the path of debt accumulation does not depend on the nature of the adjustment but rather on its timing: the later the adjustment is implemented, the higher the size of the new steady state debt stock will be. It is worth noting that foreign debt in the domestic country rises fast in the first case, because it is driven by initial appreciation and by the income effect. In the case where a monetary adjustment is expected, on the other hand, the accumulation of foreign debt is less rapid in the short run and throws back in the long run. It is evident in this second case, that the inflation rate, which in the short-run overshoots the new long run equilibrium, ends up with a positive value - just equal to the new rate of growth of nominal money.

Figure 3.A.3a and 3.A.3b show the different behaviour of the real exchange rate following a fiscal expansion: if a future fiscal adjustment is expected, a slight real appreciation on impact is followed by a further appreciation; after the fiscal adjustment a moderate gradual depreciation is needed (figure 3.A.3a). On the other hand if a monetary future adjustment is expected, the exchange rate depreciates on impact, and gradually starts to appreciate toward a new steady state value (figure 3.A.3b). Thus a fiscal expansion can be followed by a real depreciation of the exchange rate, even if the money supply has not changed, if fiscal authorities are not expected to adjust fiscal policy in the future (Galli and Masera, 1988).

The lesson to be drawn from this exercise, if any, is that, in the presence of a large public sector deficit, merely changing the expectations of future measure of stabilization of debt can have sharp effects on the domestic and foreign variables, and especially on the exchange rate.

[57] Since fiscal policy was found to be a locomotive policy, if we consider the impact multipliers (see (18)) which neglect the "news" effects, this means that these latters are strong enough to more than offset such a positive effect.

Figure 3.A.1

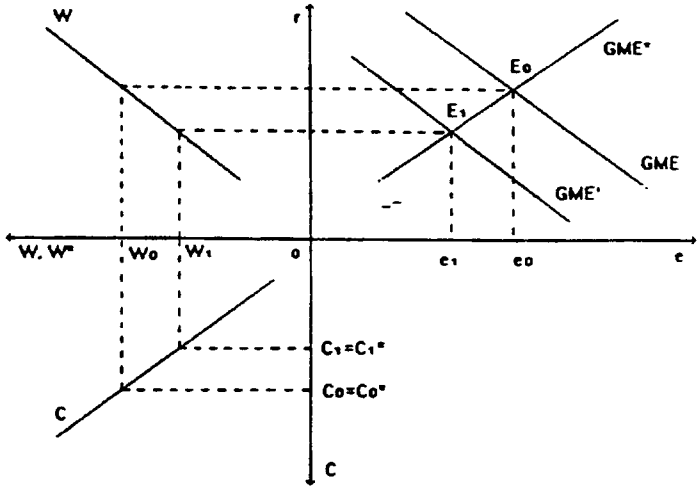


Figure 3.A.2

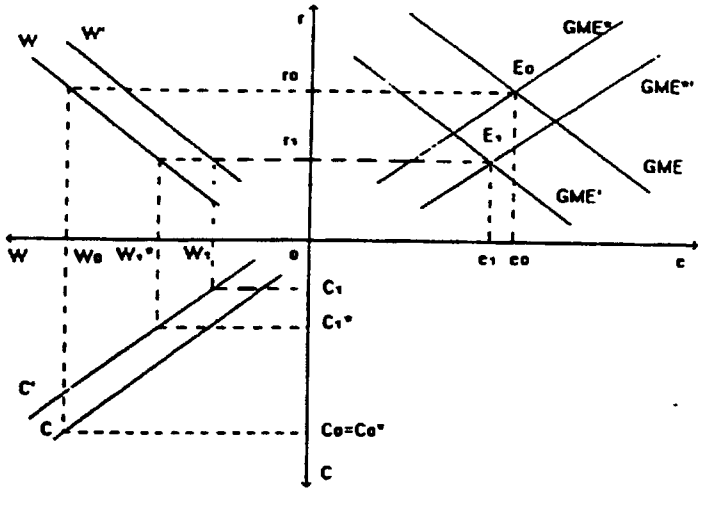


Figure 3.A.3a

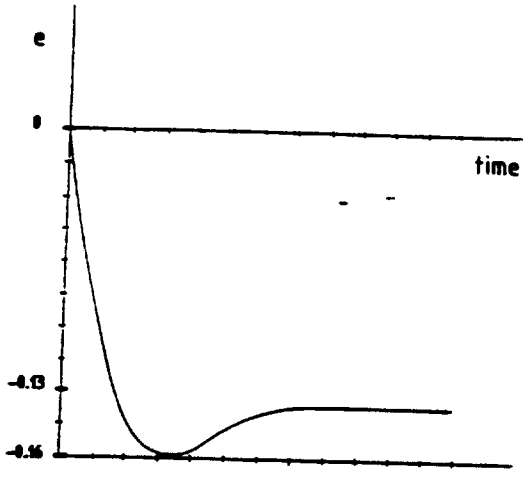


Figure 3.A.3b

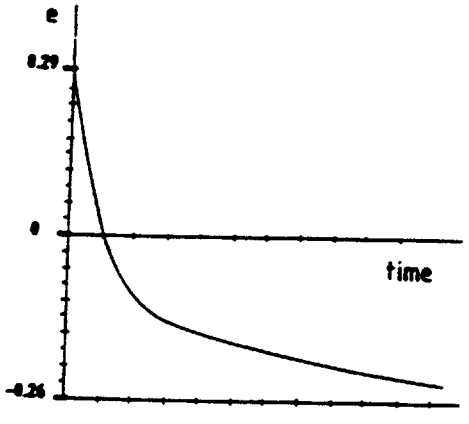


Table 3.A.2a

	0	3	19	20	∞
Domestic economy					
D	0	3.14	26.79	28.76	28.76
M	0	1.74	−2.85	−1.87	1.79
Y	−0.85	−0.68	0.37	−1.10	0
C	−1.18	−0.64	1.16	−1.65	−1.27
C_m	0.32	0.29	0.25	−0.31	−0.57
π^c	−0.09	−0.07	0.01	−0.13	−0.1
r	0.12	0.12	0.04	0.09	0.04
Foreign economy					
M^*	0	−4.63	−17.11	−17.52	−0.98
Y^*	0.85	0.64	−0.03	−1.09	0
C^*	1.18	0.56	−0.64	−0.25	1.27
C_m^*	−0.32	−0.30	−0.15	−0.36	0.57
π^{c*}	0.09	0.07	0.02	−0.07	0
r^*	−0.12	−0.10	0.00	0.06	0.04
World economy					
e	−2.86	−2.14	−0.12	−0.07	1.64
F	0	−0.41	−7.32	−3.93	−23.76

Table 3.A.2b

	0	3	19	20	∞
Domestic economy					
D	0	3.1410	36.796	28.76	28.76
M	0	−2.9377	−21.336	−22.87	−28.76
Y	0.0010	−0.0244	0.287	0.31	0
C	0.0010	−0.0499	0.436	0.48	0
C_m	−0.0004	−0.0132	0.013	0.01	0
π^c	0.0001	0.0002	0.062	0.07	0.10
r	−0.0002	0.0075	0.037	0.04	0
Foreign economy					
M^*	0	0.0534	1.350	1.42	0
Y^*	−0.0010	−0.0244	0.052	0.06	0
C^*	−0.0014	−0.0258	0.086	0.10	0
C_m^*	0.0004	−0.0019	0.091	0.10	0
π^{c*}	−0.0001	−0.0060	−0.017	−0.02	0
r^*	0.0002	0.0023	0.006	0.01	0
World economy					
e	0.0035	0.0165	0.378	0.40	0
F	0	0.0139	0.244	0.25	0

Table 3.A.3a

	0	3	20	∞
Domestic economy				
D	0	0.27	1.11	1.53
M	0	−0.17	0.52	1.23
Y	0.08	0.02	−0.05	0
C	0.14	0.10	0.09	0.18
C_m	0.03	0.02	−0.01	−0.02
π^c	0.79	0.48	−0.64	0
r	−0.26	0	0.30	0.21
Foreign economy				
M^*	0	−0.17	−0.19	−0.04
Y^*	0	0.03	−0.01	0
C^*	0.05	0.02	−0.01	0.05
C_m^*	0.01	0.01	−0.01	0.07
π^{c*}	0.50	0.33	−0.51	0
r^*	−0.33	−0.26	0.30	0.21
World economy				
e	0.20	0.71	10.17	31.24
F	0	−0.04	−0.20	−1.00

Percentage deviations (expect r, r^*, π^c π^{c*} and e, for which it is 100 times the absolute deviation).

Table 3.A.3a

	0	3	20	∞
Domestic economy				
D	0	0.27	1.11	1.53
M	0	−0.05	−0.95	−0.71
Y	0.07	0.05	−0.02	0
C	0.14	0.11	−0.04	−0.30
C_m	0.03	0.02	−0.01	−0.20
π^c	0.78	0.79	−0.01	0
r	−0.25	−0.31	0.19	0.13
Foreign economy				
M^*	0	−0.23	−0.46	−0.02
Y^*	0	0.27	−0.03	0
C^*	0.05	0.04	−0.04	0.03
C_m^*	0.01	0.01	−0.01	0.02
π^{c*}	0.51	0.50	−0.18	0
r^*	−0.34	−0.31	0.20	0.13
World economy				
e	0.01	0.17	−0.25	4.42
F	0	−0.05	−0.26	−0.64

Percentage deviations (expect r, r^*, π^c π^{c*} and e, for which it is 100 times the absolute deviation).

Table 3.A.4a

	0	3	20	∝
Domestic economy				
D	0	0.55	2.89	2.89
M	0	−1.18	−4.39	−2.62
Y	0.22	0.16	−0.15	0
C	0.22	0.14	−0.41	−0.21
C_m	0.04	0.04	−0.06	−0.02
π^c	1.91	2.24	−0.07	0
r	−1.38	−1.58	0.01	0.20
Foreign economy				
M^*	0	−0.50	−1.81	−0.04
Y^*	0.08	0.06	−0.15	0
C^*	0.08	0.05	−0.21	0.05
C_m^*	0.02	0.01	−0.07	0.01
π^{c*}	1.09	1.37	−0.07	0
r^*	−0.53	−0.75	0.55	0.20
World economy				
e	−0.17	−4.42	−13.73	−9.12
F	0	−0.15	−0.71	−1.00

Percentage deviations (expect r, r^*, π^c π^{c*} and e, for which it is 100 times the absolute deviation).

Table 3.A.4b

	0	3	20	∞
Domestic economy				
D	0	0.55	2.89	2.89
M	0	−1.92	−6.29	−5.69
Y	0.30	0.21	−0.01	0
C	0.34	0.17	−0.20	−0.08
C_m	0.01	0.01	−0.02.	0.03
π^c	2.85	2.96	1.95	2.03
r	−2.69	−2.49	−0.58	−0.29
Foreign economy				
M^*	0	0.24	0.10	0.06
Y^*	−0.01	0.02	−0.01	0
C^*	−0.03	0.03	−0.02	−0.08
C_m^*	0.05	0.03	−0.02	−0.07
π^{c*}	0.14	0.65	0.10	0
r^*	−0.77	0.16	−0.07	−0.29
World economy				
e	28.76	13.44	−8.84	−25.64
F	0	−0.06	0.12	1.42

Percentage deviations (expect r, r^*, π^c π^{c*} and e, for which it is 100 times the absolute deviation).

Part II. Policy coordination in a European Perspective

4. Exchange rate system and policy coordination: the European experience

When the European countries decided to start the process of real and financial market integration, they were faced by what became known as the problem of the inconsistent quartet. As Padoa Schioppa clearly pointed out, one cannot simultaneously have free real goods circulation, financial integration, fixed exchange rates and independent monetary policies. Two different solutions of the problem were available:

- centralising the monetary policy making either via strict coordination among national central banks or via the creation of a common European central bank assigned with responsibility for monetary policy,
- arranging an asymmetric fixed exchange rate system in which one country chooses the monetary policy while the others keep their nominal exchange rates fixed.

The Delors report first, and the Maastricht Treaty later, solved the problem by postponing the accomplishment of the first scenario to a sufficiently far future, and adopted the second solution as the short run solution to the problem. Therefore the *hard EMS* was presented as the best possible route to European monetary integration. It is now generally accepted that this choice was much more due to political opposition than to economic optimality.

Nevertheless, there is some theoretical underpinning to this choice. First of all, it has been widely argued that the fixed exchange rate system can be seen as a surrogate for full and explicit cooperation of monetary policy (Hughes Hallet, Holtham and Hutson,1989) and can replicate the effects of the more thorough-going coordination of monetary policies. This potentiality was already noticed by Oudiz and Sachs in their seminal paper on policy coordination. Under flexible exchange rates there is the temptation to use monetary and fiscal policy to move the exchange rate in a beggar-thy-neighbour manner; assuming symmetry among countries, as far as economic structure and policy objectives are concerned, this results in excessive deflation or inflation depending on whether there is a tendency towards competitive appreciation or depreciation. The use of the fixed rate arrangement as a system to avoid the competitive use of the exchange rate seems of particular importance in the case of the European countries which decide to complete and to defend the internal integrated market.

Secondly, the targeting of the exchange rate can be seen as an objective per se, in the case in which the exchange rate may be subject to excess volatility and or speculative bubbles; these may be undesirable in themselves, if policy makers care about exchange rate stability, or may cause resource misallocation.

Therefore exchange rate targeting as a surrogate for more a explicit cooperation appears to be an appealing proposal since it allows saving on transaction costs, information costs, and reduces political difficulties implied by full cooperation.

This part of the thesis will explore this proposal principally with respect to the European environment. I shall follows two different lines of enquiry: this chapter, treats the issue from a historical perspective by analysing the record of the EMS in order to verify whether the European fixed rate arrangement worked well enough as surrogate for a more complete form of cooperation and as a viable route towards monetary unification. In chapter 5, instead, the topic will be analysed theoretically by using a three country version of the model proposed in chapter 2.

4.1. The rise and the fall of the European Monetary System

In September 1992 the European monetary system was hit by serious crisis. Two leading members of the Community, Italy and Great Britain, were forced to withdraw from the system. A number of weak currencies, like the Spanish peseta and the Irish pound, were repeatedly devalued. The crisis came after a relatively long period of stability and when progress towards monetary union seemed definitively under way. The periods of turbulence that preceded and followed the crisis did not involve only the weak currencies, witnessed by the repeated speculative attacks on the French franc, apparently one of the strongest of the European currencies. To many observers, the crisis of the EMS appeared to be a crisis of the system as a whole, albeit aggravated by the marked weakness of certain currencies. This view was validated when the system failed to overcome the second major crisis in the summer of 1993: the width of the bands of oscillation dramatically increaseed from ±2.25% to ±15%. It is self-evident that with the new band width what remains of the EMS can hardly be defined as a fixed exchange rates system.

There is no doubt, therefore, that analysis of the elements which permitted the rise, and of the factors that caused the fall, of the European monetary system is important for several reasons, and it appears to be crucial if the route towards European monetary Union is to be redrawn. It is interesting to analyse whether the system was deviced and actually worked as a surrogate for more strict policy coordination among European

countries or whether, on the contrary, the lack of adequate coordination of monetary and fiscal policy among European countries was one of the most important factors inducing the crisis.

Answering the question requires analysis of the principal characteristics of the EMS. Since its creation, however, the system has undergone substantial changes. Initially it was a system of fixed, but cooperatively adjustable, exchange rates, explicitly designed to be symmetric and flexible and intended to combine the advantages of a cooperative response to possible external shocks with the advantages deriving from a certain amount of monetary independence. This early period was characterised by frequent realignments, while large inflation differentials also imposed frequent readjustments. In the next period, from 1986 onwards, the system abandoned all pretence to symmetry and was marked by its stability; realignments became increasingly rare until they ceased altogether between 1987 and the onset of the crisis in 1992 (if one excludes the technical, so to speak, devaluation of the lira following the narrowing of its fluctuation bands in 1990).

With a certain amount of approximation, we may say that in the first phase the system was not significantly different from a "crawling peg" system, in the second phase it came more closely to resemble one with fixed exchange rates.

In what follows I will concentrate on the economic rationale for belonging to the EMS as it was in its *golden age*: namely, a system with full capital mobility, with increasing financial integration, highly asymmetric "almost completely fixed" exchange rates, in which Germany decided monetary policy for the whole system and the other countries commited themselves to maintaining the parity of their currencies against the mark.

4.2. Advantages of the EMS

Four principal arguments have been advanced in justification of the EMS:

(i) it is an instrument which reduces uncertainty over exchange rates and therefore encourages infra-community trade;

(ii) it is a surrogate for more complete and explicit coordination of monetary policies;

(iii) it is an instrument with which to achieve greater inflationary discipline;

(iv) it is the obligatory path towards monetary union.

To these can be added a fifth argument, one more specifically political in character and which the system's founders certainly had in mind: the EMS favours the

greater integration and unity of the European countries. Political considerations also seem to have been the basis for the decision by the weaker countries, like Italy, to join: exclusion from the currency agreement was frequently perceived as exclusion from the process of European integration and, implicitly, as exclusion from the future share-out of the advantages from this integration combined with progressive economic and political marginalization. Pointing this out is important for the following two reasons. Firstly, this attitude seems to be resurfacing now that the step towards further monetary integration seems near at hand. Secondly, Britain's experience shows that its belated membership of the EMS did not prevent it from fully reaping the advantages of Community integration.

The four arguments set out above are not mutually exclusive, except for (ii) and (iii). They represent the chief interpretations of the EMS; interpretations which are often in conflict with each other because they are two different and opposing ways of resolving the problem known as the 'paradigm of n degrees of freedom'.[1] In a particular currency area, there can be one and one only monetary authority. Therefore, either political and economic independence is granted to only one country (Great Britain during the period of the Gold Standard, the United States during the Bretton Woods period) thus giving rise to a hegemonic system, or the responsibility for monetary policy is divided equally among the countries in the union, giving rise to a cooperative system.

This is not the place for examination of the above arguments one by one, or for extensive analysis of the debate between the advocates of the disciplinary and cooperative interpretations of the EMS. The reader is referred to a number of recent publications for detailed treatment of the topic [2]. I shall instead seek to assess how far these arguments exert a positive influence on the decision to rejoin the EMS.

4.2.1. Exchange rate uncertainty and infra-community trade

Numerous empirical studies have confirmed that the EMS has brought significant reductions in uncertainty over exchange rates among member countries [3]. Still controversial, however, is the question of whether this important outcome has been achieved at the cost of increased uncertainty over other variables, for instance short-term interest rates (Artis and Taylor 1988, Rogoff 1985a).

1 If n countries join a currency union, in which exchange rates are fixed, only n-1 parities can be predetermined and there is a degree of freedom in fixing the common monetary policy.

2 See, for example, De Grauwe 1992, Fratianni and von Hagen 1992, Gross and Thygesen 1992.

3 See Fratianni and von Hagen 1990a, Rogoff 1985a, Artis and Taylor 1988, Weber 1990

More relevant to the present purposes is Fratianni and von Hagen's (1990b) finding that there is a trade-off between uncertainty about exchange rates within the EMS and uncertainty about exchange rates among currencies internal and external to it. Obviously, the importance of this phenomenon depends on the share of infra-community trade of each individual economy. According to Fratianni and van Hagen, reduced uncertainty over infra-EMS exchange rates has been accompanied by increased uncertainty over the dollar, yen and sterling exchange rates. This result squares with the observation that the variance in the effective exchange rate has not changed for the EMS countries (Ungerer et al. 1986).

The extent to which reduced uncertainty over exchange rates among the EMS member countries has stimulated infra-community trade is, to say the least, ambiguous. Inspection of the figures in Table 4.2.1 seems to suggest a perverse and negative effect. The fall in export shares within the EMS, however, can be partially explained by the lower rate of growth achieved by the European countries compared with the other industrialised countries.

Table 4.2.1.

Relative shares of EMS exports in percentages

	Belgium	Denmark	France	Germany	Italy	Holland	EMS
1976	79.3	34.3	66.3	57.5	64.3	76.0	64.1
1978	77,3	40.3	65.2	55.6	62.6	76.6	63.1
1980	74.8	42.8	64.8	55.8	62.8	77.0	63.3
1982	72.5	41.6	61.4	54.5	59.3	74.8	60.9
1984	70.3	37.0	58.0	50.3	54.6	72.9	57.3
1986	72.5	39.3	58.1	48.2	55.6	71.5	56.4
1988	74.9	49.8	61.6	54.3	57.5	75.3	59.9
1990	75.9	52.1	62.8	54.5	58.6	77.3	61.4
1991	76.0	54.1	63.6	55.0	59.4	76.9	n.a

Note: relative shares are given by the ratio between exports to EMS countries and total exports.
Source: Fratianni and van Hagen 1990b updated with EUROSTAT figures.

4.2.2. The EMS and the credibility of monetary policy

The interpretation of the EMS as an instrument with which to apply inflationary discipline on errant member countries acquired increasing plausibility during the 1980s (Giavazzi and Pagano 1988, Giavazzi and Giovannini 1987, 1988, 1989).

The basic idea stems from Barro and Gordon's (1983) model: a positive level of equilibrium inflation comes about when the central bank is unable to make credible commitment to a policy of zero inflation. Because the rate of inflation depends directly

on the preferences of the policy maker, Rogoff (1985b) proposes the appointment of a "conservative" central banker; i.e. a governor with strong anti-inflationary preferences, as an effective anti-inflationary measure. Countries with low credibility may, by undertaking to fix their parities to the mark, delegate their monetary policy to the Bundesbank, which under this arrangement assumes the role of conservative governor.

For an explanation of this kind to be coherent, the following hypotheses must be confirmed:

(a) the credibility lacking on the side of monetary policy must be present on that of exchange policy;

(b) the fixed exchange rate agreement must be advantageous to the member countries;

(c) inflation must be entirely the result of the monetary authority's inability to commit itself to optimal policies;

(d) the system must operate asymmetrically: Germany decides monetary policy for the entire area, and each country fixes its parity with the mark.

4.2.2.1 The credibility of the exchange rate arrangement

Even if Barro and Gordon's model is accepted, one must still explain why fixing the exchange rate is a policy capable of achieving the credibility that a policy of fixing monetary policy instead lacks. The reason cannot be the fact that the exchange rate is a variable which is more easily observed and monitored, because Barro and Gordon's model presupposes that also the quantity of money, or other possible indicators of monetary policy, are perfectly known to private agents. The explanation must lie externally to the model and must postulate that devaluation incurs costs of a political nature which balance out the incentive of the monetary authority to devalue unexpectedly. These costs may be justified by the fact that (a) devaluation is usually perceived as a failure of government policy, and (b) the entire community regards devaluation as a blow to the country's international prestige.

4.2.2.2 The advantages of the exchange rate arrangement

Even if the exchange rate policy is taken for granted, the economic convenience for both the high inflation country, say Italy, and the low inflation country, say Germany, of adhering to a rigid exchange rate agreement does not follow automatically. Under the hypothesis that Germany does not change its policy after the agreement, the advantages for Italy are assured: it obtains an inflation rate lower than it could achieve with flexible

rates, and without costs in terms of lower output [4]. This hypothesis, however, is untenable in Barro and Gordon's model: the exchange rate agreement alters the trade-off between inflation and output perceived by the German policy-maker by diminishing the costs in terms of inflation of an unannounced increase in the money supply. The Bank of Italy follows the Bundesbank's monetary policy and therefore "imports" part of the inflation generated by German monetary expansion Which means that the rate of inflation of the whole system is higher than Germany's would be in a regime of flexible exchange rates. This outcome raises two problems: the advantage to Italy is no longer guaranteed, but now depends on the parameters of the model;[5] the disadvantage to Germany is, instead, unequivocal. One has to explain, therefore, why Germany should decide to adhere to an exchange agreement of this kind with Italy. Once again the explanation, if one exists, lies externally to the model.[6]

From what has been said, it appears that the theoretical justification for the EMS as an instrument with which to achieve otherwise impossible monetary discipline is incomplete and unsatisfactory. Of course, this does not mean that the EMS has not played a part in reducing and converging the inflation rates of the member countries. In order to evaluate the effectiveness of this role of the EMS, analysis of the empirical results is required.

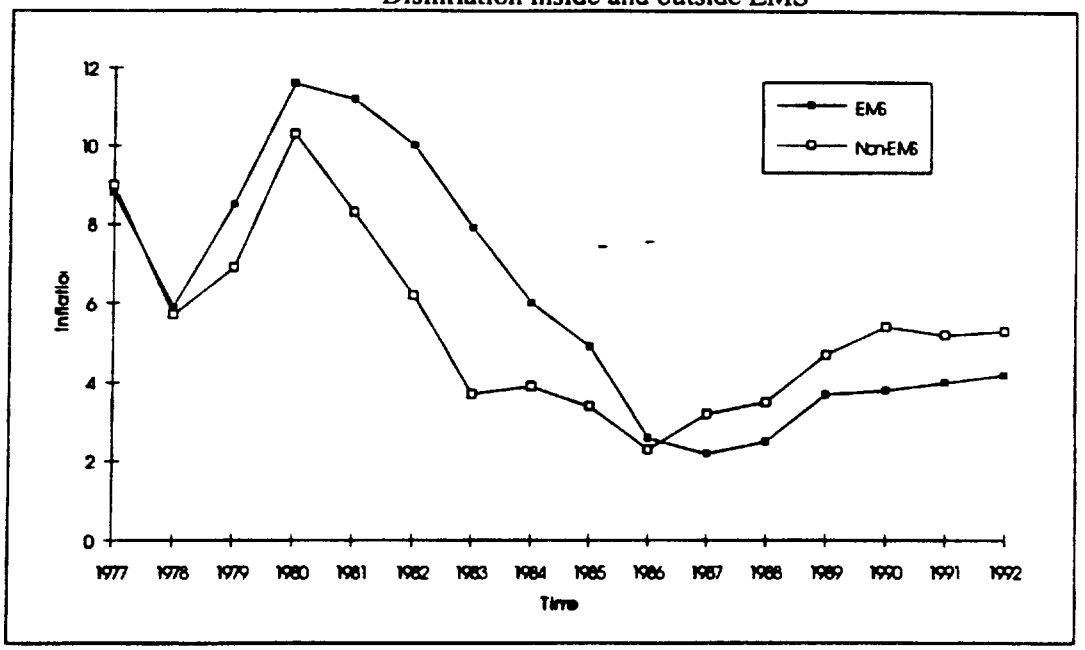
Figure 4.2.1 compares the average trend of inflation in the countries that belong to the EMS with those of the principal countries that do not. Whereas in the first phase of the EMS, the performance of the EMS countries was clearly inferior to that of the non-EMS ones, from 1987 onwards the average inflation rate of the EMS countries was lower than that of the non-EMS ones. At first sight, therefore, these figures seem to confirm the view that the EMS operates as a disciplinary instrument. In the second phase of the EMS, in fact, when the fixing of parities gained credibility, this mechanism came into operation. Some remarks, however, are in order.

4 This does not explain the advantageousness to Germany of this arrangement. See below, however.

5 It has been shown that the greater the integration between the two countries, the less Italy benefits from participating in a fixed exchange regime.

6 It has been proposed, for example, that Germany draws advantage, in terms of trade, from the tendency of other currencies to be overvalued in real terms with respect to the mark. (Melitz 1988 and Giavazzi and Pagano 1988). Although not without a certain validity, this explanation has two consequences which should be stressed. First, it presupposes that the Italian inflation rate is slow in converging with the German rate, and this contradicts the base hypotheses of Barro and Gordon's model, and in any case it only holds for the period of adjustment. Second, it confers chronic instability on the system by hypothesising persistent trade imbalances.

Figure 4.2.1.
Disinflation inside and outside EMS



Appreciable disinflation and the downwards convergence of inflation rates are not features exclusive to the countries belonging to the EMS.[7] Although, therefore, a reduction in inflation more or less comparable to that achieved by the EMS countries was also obtained by non-EMS countries in Europe - Great Britain and Spain for example - the disciplinary approach can still be defended by arguing that the costs of disinflation have been lower in the EMS countries. The studies so far carried out in this regard, however, fail to support this thesis. Giavazzi and Spaventa (1989) and Dornbusch (1988) have calculated "sacrifice ratios" inside and outside the EMS without finding significant differences between the two blocks of countries.[8] De Grauwe (1990) has used a "misery index" - unemployment plus inflation - as a measurement of the cost of disinflation. This index has always been higher in the EMS countries than in certain OECD countries, both

7 Two important factors account for this widespread process. First, all countries, belonging to the EMS or otherwise, were affected during the 1980s by the same inflation-reducing shocks. Second, these years were marked by a general change in both the politico-social equilibria that restricted the growth of labour costs and in the attitudes of the economic policy authorities, which became increasingly less willing to sustain the economy by expanding internal demand.

8 The 'sacrifice ratio' is the ratio between the amount of unemployment accumulated since a base year and the total reduction in inflation.

before and after 1979, and, more interestingly, it increased after 1980 in the EMS countries.[9]

4.2.2.3 The "excess of credibility" hypothesis

Should inflation prove to have causes which differ at least partially from the monetary authorities' lack of credibility, a fixed exchange rate policy would have higher costs in real terms and lower advantages in terms of inflation. In this case, in fact, the inflationary differential would tend to persist, thereby creating a tendency towards the revaluation of the real exchange rate; and the inflation differential would, moreover, weaken the credibility of the commitment to exchange stability.

Figure 4.2.2

Inflation rate of Italy and Germany

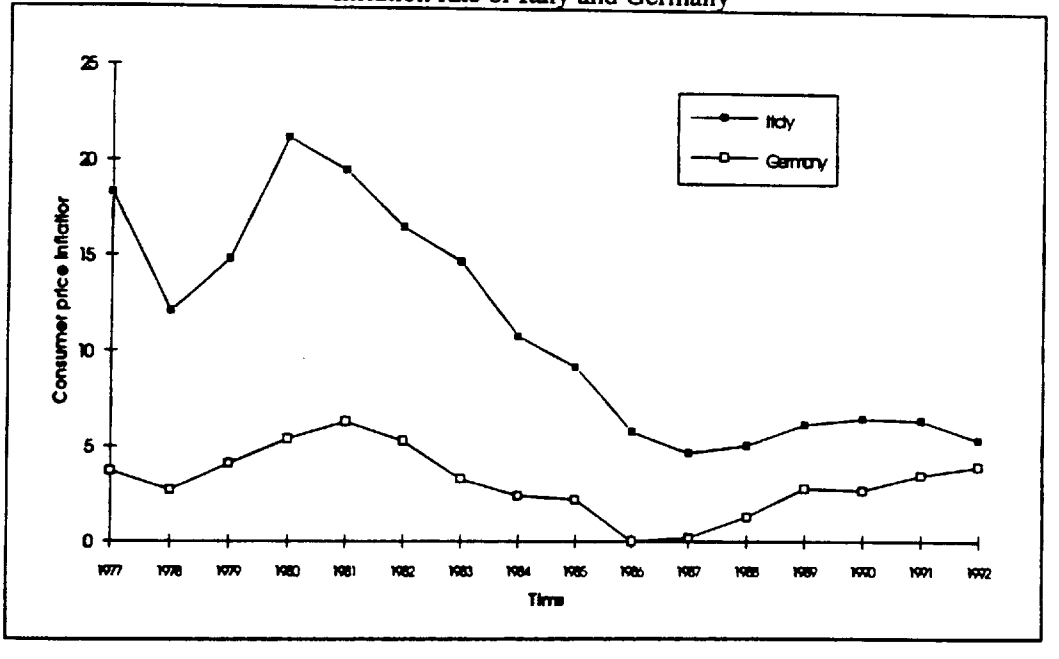


Figure 4.2.2. shows the differential between the inflation rates of Italy and Germany. The tendency for the differential to diminish is obvious; it slows noticeably after 1987 and reverses direction in 1990. This pattern contradicts the theory, given that it

9 According to De Grauwe, this result can be explained by the slower process of disinflation in the EMS countries. Countries outside the EMS mostly resorted to shock therapy which provoked a sharp but short-lived recession. In the EMS countries, however, disinflation was more gradual and extended the economic costs over a longer time-span. Only by assuming a high degree of policy shortsightedness among the EMS countries, i.e. a high intertemporal discount rate, can one maintain that the costs of disinflation have been lower in the EMS countries.

was precisely in this latter period that the nominal exchange rate between the lira and the mark remained stable. This testifies to the credibility acquired by the fluctuation band and indicates that the EMS as an instrument of monetary discipline should function better. The persistence of an inflationary differential seems to show that Italian inflation is caused by factors other than the ability of the Italian authorities to pursue credible anti-inflationary policies. Should this be confirmed, on the one hand the costs in terms of output of a disinflation policy based on fixed exchange rates would increase, because of the continuous revaluation of the exchange rate; on the other, the system would be balanced on a knife-edge. In fact, as soon as the market realised that the inflation differential was destined to persist, provoking excessive costs in terms of competitiveness and payments imbalances for the economy with the higher inflation, expectations of devaluation would intensify and the central parity would no longer be defensible.

The following explanation of the persistence of an inflation differential has been proposed. When central parities gain credibility, and expectations of the devaluation of the currencies of the countries with high inflation are therefore reduced to the minimum, nominal interest rates rapidly converge, while real rates tend to be lower in the higher-inflation countries: an effect in itself perverse and which, by stimulating demand in the high-inflation countries, would slow down the reduction of the inflationary differential. In the recent past, Alan Walters (1986) has cited this perverse effect to advise against English participation in the EMS. A similar argument has been subsequently advanced by several writers (Giavazzi and Spaventa 1990, and Bini Smaghi and Micossi 1990) and labelled the 'paradox of excessive credibility'. The crucial point in this argument is that the impact of credible commitment on exchange rate stability is greater on the financial markets than on the commodities and labour ones, where expectations are revised more slowly. However, should anyone seek empirical confirmation for these hypotheses, they will find it difficult to come by: although it is undeniable that demand in real terms has grown more in Italy than in Germany - a result which confirms the hypothesis - real interest rates tended to increase in both absolute terms and relative to Germany's during the years of Italy's membership of the EMS, and this contradicts the hypothesis.[10] The further observation concerning the persistence of a high differential in nominal long-term rates is difficult to reconcile with the hypothesis of excessive credibility.

10 The recent empirical study by Artis (1992) confirms this scepticism.

4.2.2.4 The German dominance hypothesis

For the interpretative hypothesis of the EMS as an instrument of monetary discipline to be coherent, it is necessary for the European monetary system to function in a perfectly asymmetric manner: Germany fixes monetary policy for the entire area and the other countries fix their currencies according to the mark. This has been called the German Dominance Hypothesis (GDH).

The empirical evidence so far available (Fratianni and von Hagen 1990a, Cohen and Wyplosz 1989, Weber 1990, among others), however, rejects this hypothesis. The position of the Bundesbank in the EMS seems better described as one of long-term independence, not of dominance (Fratianni and von Hagen 1992).

This result should be interpreted with care, since at first sight it may appear contradictory. The paradigm of the n degrees of freedom entails that the independence of the German monetary authority must inevitably be accompanied by the dependence of the other central banks. This contradiction, however, is only apparent if one remembers the two release valves that the system frequently used until the 1990s: the realignment of exchange rates, and the restriction of capital movements by means of administrative controls. These two mechanisms ensured that German independence did not automatically turn into dominance. This, however, obliges us to conclude that in a situation in which these two release valves were definitively closed, German hegemony would effectively come about.

However, the stability of a system of fixed exchange rates under German dominance, in which monetary policy was determined exclusively by the Bundesbank, and in which inflation differentials tended to persist, would be rather low, unless one assumes that one of the aims of the Bundesbank was to guarantee the stability of the system by refraining from policies which would undermine its stability. In this case, however, the interpretative model would no longer be the one based on German dominance and would instead become a system based on cooperation among monetary policies.

4.2.2.5. The persistence of an inflationary differential: an alternative explanation

The persistence of an inflationary differential comes much less as a surprise if one abandons the rather simplistic hypothesis of the existence of one sole good - a hypothesis that has been overworked in the most recent models of international finance. If, instead, one also considers goods that are not internationally tradable, the rate of inflation of one

country may remain higher than that of another - even in the presence of fixed nominal exchange rates - if the relative price of non-tradable goods persistently rises.

The price level is equal to a weighed average of the price of tradable goods (p^T), which the fixed exchange rate equalises, and of non-tradable goods (p^{NT}):

$$p_t = \omega p_t^T + (1-\omega) p_t^{NT}$$

Dividing both members by the price of tradable goods, we obtain:

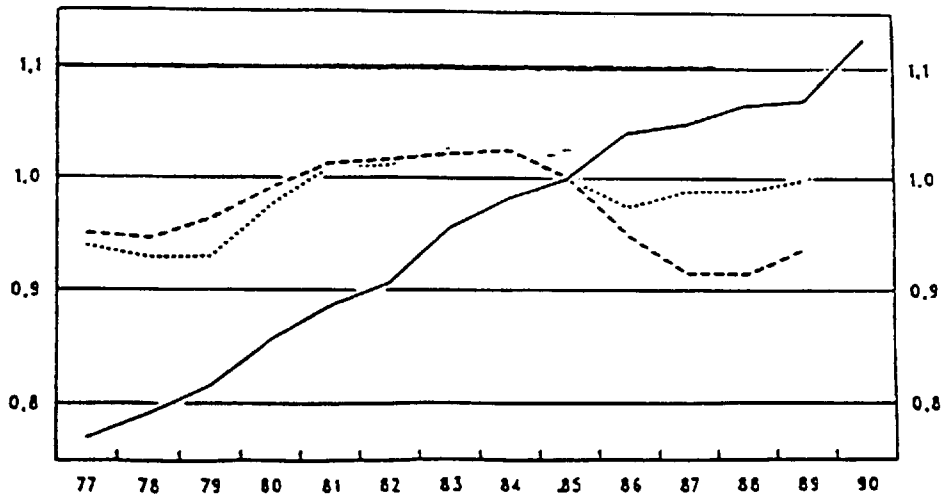
$$\frac{p_t}{p_t^T} = \omega + (1-\omega)\frac{p_t^{NT}}{p_t^T}$$

It is obvious that in order for the rate of inflation in a country to be higher than that in another country (so that $\frac{p_t}{p_t^T}$ increases over time), the relative price of non-tradable, $\frac{p_t^{NT}}{p_t^T}$, must increase in a persistent manner. Figure 4.2.3. shows that this increase in the relative price of non-tradable has, in fact, been the main force working against the convergence of Italian inflation towards the German and French rates. This figure shows the ratio between the value added prices in the service sector and in the industrial sector: whereas this increases in Italy, it tends to decrease in both Germany and France.

It is therefore evident that, far from being entirely due to the monetary authorities' lack of credibility, Italian inflation also stems from structural factors sustaining the endogenous component of inflation. Exhaustive treatment of these mechanisms would be beyond the purview of this paper (see Barca and Visco 1992 and Visco 1992). It is clear, however, that the low rate of productivity growth in services, combined with an adjustment of the levels of wages growth to those obtaining in industrial sectors, where productivity growth has been higher, is a major cause of the increase in the relative price of services.

The most important consequence of the persistence of inflationary differentials concerns the stability of the system and the credibility of the central parities. Given the entirely free movement of capital, the credibility of the central parities appears to be crucial for the stability of the system. However, in the presence of permanent inflationary differentials, this credibility rapidly disappears due to costs in terms of lost competitiveness for the country with the highest inflation, and due to the trade disequilibria that derive from it.

Figure 4.2.3.
Growth differentials between value added prices of services and of goods:
(1985 prices = 1)



____ Italy, _ _ _ Germany, ... France

Source: Visco (1992) fig. 7

4.2.2.6. The EMS as an instrument of inflationary discipline

Theoretical analysis and empirical evidence seem to agree in stressing that the EMS, at least until the mid-1980s, was unable to perform the role of an instrument of inflationary discipline that the theory advocated. The countries belonging to the EMS did not show a disinflationary process significantly different from that of countries outside the agreement; they did not sustain significantly lower costs (indeed some studies maintain the contrary); the German dominance hypothesis, necessary for the coherence of the theory, was rejected by econometric studies; the underlying theoretical model appeared weak and unable to explain the phenomenon. When subsequent financial liberalisation and the rejection of the realignment instrument rendered this interpretative model theoretically viable, the EMS displayed high instability because of the persistence of the inflationary differential.

Of course, this does not mean that the exchange rate system played no role in the disinflation process. Certainly, on the one hand the political superstructure of the EMS and its functioning mechanism with, on the other, the short-term stabilising role that the

fluctuation bands can fulfil when parities are credible, enabled Italy to pursue a policy of a *strong lira* which otherwise would probably have been impossible. Membership of the EMS and the refusal to undertake compensatory devaluations of the inflationary differential broke the inflation/deflation spiral that typified the decade 1975-85. The external constraint imposed by the EMS, moreover, provided the Italian government with justification for its unpopular policies and rendered it less susceptible to demands for compensatory policies by the social partners. However, the most important reasons for the disinflation process in Italy lie elsewhere. Giavazzi and Spaventa (1989) have stressed that certain politico-social events, such as the 1984 referendum on the wage-indexing system ("*scala mobile*"), had a much more marked effect on expectations of inflation caused by membership of the EMS.[11]

The consequences of the argument so far can be summarised as follows. If one entirely accepts the credibility hypothesis, then a "hard" EMS, i.e. one with practically immutable parities, becomes essential to maximise the benefits of belonging to the EMS. If, instead, one assumes a somewhat less critical attitude towards the credibility hypothesis, then also a "soft" EMS, one which does not dispense with the realignment instrument, may provide valuable assistance in the struggle against inflation. While the former option raises serious problems of stability and rigidity, the latter appears relatively more stable and certainly more flexible.

4.2.3. The EMS as the obligatory path to monetary union

The European monetary system has been often described as a necessary component in the transition phase towards more complete monetary union. The costs of belonging to an exchange arrangement, therefore, must be assessed not only in terms of the advantages of the EMS in itself, but also and principally in terms of the future advantages of monetary union. Of course, this assertion only makes sense if one considers the present system to be a credible path towards complete monetary union.[12]

The Treaty of Maastricht, which in part endorses and in part modifies the celebrated Delors Report (1989), describes the three phases required to achieve monetary

11 Note that this statement raises doubts over the theory that holds that inflation results from a lack of credibility: limiting the wage index-linking in the models used by theoreticians of this school should have the opposite result, given that it positively adjusts the trade-off perceived by the policy-maker between inflation and employment.

12 I shall not go into the debate on the advantages and disadvantages of monetary union, taking it as granted (with a goodly dose of optimism) that a monetary union with a single currency brings net advantages.

union. The first phase, by now concluded, involves complete financial liberalisation among the countries of the Community. The third phase involves the birth of monetary union; that is, it stipulates that exchange rates become irrevocably fixed, although what the actual features of this union should be, whether national currencies are to remain or whether they are to be superseded by a single European currency, is not made clear. The second phase comprises the crucial period of transition towards monetary union, and it warrants closer examination.

There are two possible paths to monetary union. The more rapid path, based on shock therapy, envisages the rapid realisation of monetary union;[13] most of the monetary unions in history have followed this path.[14] The monetary unification which recently took place in Germany came about suddenly and, technically, with success.[15]

The path chosen by the EEC countries with the Maastricht Treaty, though, is that of a slow and gradual approach; a path which raises two rather important problems.

In the absence of close coordination of economic policies, and with the persistence of full political and economic autonomy, each national government will be induced to pursue policies apparently incompatible with the objective of the monetary stability of the future union. In other words, there will be an incentive for each country to present itself on unification day with an inflation rate, a public deficit and a stock of public debt standing higher than the average of the other countries, so that it can off-load part of the adjustment costs on its European partners. To overcome this obstacle, the treaty envisages that passage to union will not be automatic, but that it will instead be conditional on the satisfaction of certain convergence criteria.[16] The currency constraint imposed by the EMS. with its narrow fluctuation bands may, first, make it easier to achieve these objectives, both directly in the case of the inflation rate convergence, and indirectly by the restrictions it would impose on fiscal authorities. Second, it represents,

13 From a strictly theoretical point of view, the recipe is simple. On a specified day the citizens of the European countries convert their national currencies into, say, ECUs at a specific rate of exchange. Thereafter the ECU is the sole currency of the Community. The European Central Bank becomes the issuing institution and the authority of monetary policy.

14 Information on monetary unification in Germany and Italy can be found in Holtfrerich 1989 and Sannucci 1989.

15 On German monetary union see Kalmbach 1992 and Wills 1991.

16 A country can join the EMU only if: (i) its rate of inflation is no more than 1.5% higher than the average of the lowest three rates of inflation among the EMS countries; (ii) its long-term interest rate must be no more than 2% higher than the average rate of the three countries with lowest inflation; (iii) it must not have devalued in the three years leading up to the union; (iv) its public deficit must not exceed 3% of its GDP; (v) its public debt must not exceed 60% of its GDP.

within the logic of the treaty, the ideal environment for a gradual approach to monetary union.

The following proposition seems to underlie this position: the European countries do not exhibit real and profound divergences and disequilibria, neither internally nor among themselves, and the only source of turbulence and instability is their national governments.[17] The best policy in this case is to limit to the maximum the discretionary powers of the economic policy-makers, by constraining their action to that of an external institution which enjoys full autonomy: while the exchange agreement constrains the monetary authorities, the non-entry clauses constrain the fiscal policy-makers. Only from this point of view can the reversal of the means-end nexus underlying the Maastricht Treaty be understood: it is not monetary union that enables disequilibria and disparities to be overcome and induces convergence of macroeconomics indicators; rather it is the convergence of these indicators that makes monetary union possible.

The other problem concerns the intrinsic instability contained in the Treaty in itself (Eichengreen and Wyplosz, 1993). One of the convergence criteria required of countries qualifying for EMU is that they maintain exchange rate stability (defined as keeping their currencies within their EMS fluctuation bands *without severe tensions* for a minimum of two years prior to the outset of the monetary union). A speculative attack forcing a devaluation that prevents a country from satisfying this requirement might, by eliminating the lure of the EMU membership, induce its government to abandon the current policy regime. Since the country, once driven out of the EMS, might no longer qualify for EMU, it would have no incentive to continue pursuing the policies of austerity necessary to gain entry. A speculative attack, then, can prove self-fulfilling. The theoretical underpinning of this explanation is the literature on balance of payment crisis which uses the notion of self-fulfilling speculative attacks and multiple equilibria (Obstfeld, 1986).

These considerations lead to the conclusion that a "hard" EMS - that is, one with narrow bands, without frequent realignments, and hegemonic (i.e. in which monetary policy is decided by the Bundesbank for the purpose of internal equilibrium) - does not seem a viable route towards monetary union. The sacrifice of an economy which decides

17 Of course, such a hypothesis fits well with the above-mentioned Barro and Gordon model, where the main cause of inflation is not economic but political: namely, the lack of institutional instruments with which to tie the hands of future governments.

to sustain the high costs of EMS membership by counting on the future benefits of a monetary union appears, in the light of the above, a sacrifice most likely to be in vain.[18]

The question arises, at this point, as to why the authorities of the EEC countries should have chosen an uncertain and risky route to monetary union. The answer can only be political in nature, and as such lies beyond the scope of this analysis. Nevertheless, mention must be made of the fact that a gradual approach allows postponement of the crucial political decision, just as political responsibility for the failure of the process can be shifted onto non-fulfilment of the non-entry clauses.

4.2.4. The EMS as a cooperative instrument

There is no doubt that at the moment of its creation, the EMS was conceived as a surrogate for more explicit cooperation over monetary policy. This is evident not only when one reads the documents and declarations that led to the birth of the EMS, but also when one analyses the initial features of the system. These were designed to ensure the more efficient absorption of shocks exogenous to the economy of the European countries: a cooperative policy eliminates recourse to beggar-thy-neighbour exchange policies, whether devaluationary (to improve the trade balance) or revaluationary (to blunt inflation by exporting it).

The fixing of the exchange rate is, from this point of view, a specific form of coordination among monetary policies with the advantages that it is easy to monitor, discourages the forms of cheating possible in cooperative regimes, and does not entail the costs of frequent renegotiations of common policy. By contrast, it has the disadvantage of being sub-optimal with respect to a complete form of coordination. How distant this surrogate is from the original depends, of course, on the nature of the external shocks that affect the system and the amount of interdependence among the national economies. Major asymmetric shocks affecting economies with a low amount of interdependence require that adjustment of the exchange rate must be an important ingredient of optimal policy, whereas symmetric shocks affecting closely integrated countries may be effectively dealt with without altering the parity.

The advantage of the cooperative interpretation of the EMS is that it explains Germany's participation in the exchange arrangement: the desire to build a system that

18 The conclusion may be different if, instead of a hard and hegemonic EMS, one considers an EMS with broader and cooperatively managed bands of fluctuation.

can provide a common European response to an American monetary policy often viewed as highly unstable.

It should be remembered that this interpretation of the EMS does not entail that the system must function symmetrically. Even a system operating in an asymmetric manner can be more beneficial, both to the countries which peg their parities to the mark and to Germany, than one in which there are decentralised monetary policies and flexible exchange rates. The German central bank, however, cannot operate with complete independence, given that the shocks affecting the other member countries will affect, directly or indirectly, Germany as well. This explanation therefore seems more compatible with the empirical results that indicate a less than perfect asymmetry.

Within this framework, a crisis of the system arises when asymmetric shocks (German unification, for example) make alteration of the parity rate essential for correct readjustment, particularly as regards those countries, like Italy, which are not yet closely integrated with the German economy.

4.3. The costs of the EMS

The costs of membership of a fixed exchange rate arrangement essentially take the form of a loss of monetary independence and of the inability to use the exchange rate instrument. Therefore, in order to assess the costs of membership of the EMS we must specify the degree of exchange rate rigidity and the degree of monetary independence. I have already mentioned on several occasions that the EMS has passed through two stages: in the first, the possibility of frequent realignments and the existence of controls on capital movements meant that membership of the system had not completely compromised monetary independence; in the second, instead, commitment to non-realignment and the free circulation of capital almost entirely eliminated monetary autonomy.[19] The costs of EMS membership should therefore be judged according to the model of the EMS considered.

4.3.1 The exchange rate

When two countries are hit by asymmetric shocks - for example, a shift in international demand - the optimal solution may be to change the exchange rate. This use of the exchange rate instrument is justified in cases where there is a rigidity of prices and wages

19 Note that their loss of monetary independence should not be considered a cost for all the countries concerned. If inflation is engendered by the monetary authorities' lack of credibility, the the loss of independence to a more credible external institution is a positive development.

and low mobility of the production factors. If, in fact, prices and wages adjust immediately, a movement in relative prices will come about such as to balance out the demand effect and prevent it from affecting income and employment. Otherwise there may be a shift in manpower away from the country with falling demand towards the one with rising demand. Conversely, in the case where prices and wages are not flexible and the workforce has low mobility, a variation in the exchange rate may resolve the problem created by the initial shock.

There are, however, other policies which can be used in place of the exchange rate: notably, the fiscal instrument. Fiscal administration can be employed to transfer resources from the country which has benefited from the shift in consumer demand to the country which has paid the price of it. This, though, presupposes the existence of a federal fiscal system or of a coordination of fiscal policies between the two countries. In fact, it is the existence of a federal fiscal system which distinguishes the case of two countries joined in currency union from that of two different regions of the same national state (Sachs and Sala-i-Martin 1991; Eichengreen 1990). Sachs and Sala-i-Martin, for example, maintain that the American federal tax system responds appreciably to regional shocks by offsetting them to around 35 per cent by means of lower tax revenues and greater transfer.[20] There is no such mechanism at the moment in Europe, and the plan to accompany monetary unification with an expansion of the Community budget has been shelved. A currency union which cannot count on the shock-absorber function of a relatively wide-ranging fiscal apparatus, therefore, does not seem an efficient solution.

We have so far taken it for granted that varying the nominal exchange rate is an effective measure. Indeed it is, but only as a first approximation and only in the short term. As regards the long term, it is necessary to establish whether a variation in the *nominal* exchange rate is able permanently to alter the *real* exchange rate. In the above case, in which a country experiences a drop in demand for its products, in the short term nominal devaluation of the exchange rate corrects the negative shock, but in the long term it causes an increase in domestic inflation which counterbalances the first positive effect. The rapidity and importance of this counter-effect depends on the degree of the wage index-linking and the extent of the economy's openness. The more open the economy and the greater wage index-linking of the country which has devalued, the more rapidly will the positive effect of the devaluation fade.

20 von Hagen (1992) has reported different results.

The cost of belonging to a currency union in terms of the loss of the exchange rate instrument depends on the openness of the economy concerned: the less open the economy, the more it stands to lose by joining a monetary union.

Table 4.3.1 shows that there are wide differences among the degrees of openness of the EEC countries. In particular, Italy's openness compared with the other European nations is rather low, and it will therefore have to pay a very high cost should it decide to join a system of fixed exchange rates with the other European countries. If one also remembers that Italy recently abolished its system of automatic wage index-linking, one may conclude that Italy would incur a very high cost from losing exchange rate flexibility.

Table 4.3.1

Intra-community exports by EEC countries (as a percentage of GDP)

Ireland	50.1
Belgium	49.8
Holland	40.0
Portugal	19.6
Germany	16.1
Denmark	13.9
France	12.5
Greece	11.6
Great Britan	9.5
Italy	9.4
Spain	7.1

Fonte: EC Commission (1990)

4.3.2 The inflation rate

A system of rigid exchange rates presupposes that the inflation differential is very close to zero. We have already examined the possible consequences of a situation of slowly-converging inflation rates for the systemic stability and the economic competitiveness of a higher-inflation country. This section will briefly deal with the economic convenience for two structurally different countries to have the same rate of inflation.

When it was believed that there was a long-term trade-off between inflation and unemployment, the inflation rate was made to depend on the slope of the Phillips curve and on the preferences of economic policy-makers. In this case it was perfectly possible for two countries to have different desired inflation rates, and there was no rational

reason for forcing the differential down to zero.[21] Now that faith in a long-term stable Phillips curve has crumbled, and the thesis of its long-term verticality is widely accepted, no reasonable defence of the thesis of monetary independence can be advanced, and the objective of a convergence of inflation rates towards the long-term minimum is accordingly difficult to criticise. However, this does not mean that, in the short period, an individual country is prevented from choosing its own convergence path towards the minimum of inflation. Short-term trade-offs may differ for the two countries, and this may justify their adoption of different short-term policies and different inflation-reducing strategies. Membership of a fixed exchange rate system, therefore, presupposes acceptance not only of a long-term trade-off between inflation and unemployment, but also of the convergence path towards monetary stability. The economic convenience of this choice, which cannot be established a priori, should be assessed by setting the advantages in terms of greater credibility against the possible costs arising from the choice of a convergence path other than that desired. For example, when the inflation differential is particularly high - which means that expectations of inflation are high and sluggish - the advantages, in terms of credibility, of belonging to a fixed exchange rate system for the country with higher inflation are considerable; indeed, probably higher than those of a loss of monetary autonomy in the short run.

The modern theory of optimal public finance suggests another reason why inflation rates may reasonably diverge (Fischer 1982; Grilli 1989). A government will draw on different sources of fiscal revenue in order equalise their marginal cost. If the marginal cost of fiscal revenue is greater than zero, as is likely, then seigniorage too can be used as an instrument of fiscal revenue. Two countries with different structures of fiscal administration may have different levels of seigniorage and therefore different levels of inflation.

A country like Italy, which has a backward tax system with widespread evasion, pays the price of a lower-than-optimal level of seigniorage in order to join a fixed exchange rate arrangement.

21 The possibility of autonomously fixing the inflation rate was one of the principal reasons why during the Bretton Woods period many monetarists were in favour of a flexible exchange rate regime which guaranteed maximum monetary independence.

4.4. Costs and benefits compared

The European monetary system, in the form that it has taken in recent years, is a system with "almost completely" fixed exchange rates operating asymmetrically, in which Germany establishes monetary policy for the entire area and the other countries peg their currencies to the mark. Dominance-based international monetary systems work as long as the dominant country provides the public good that justifies its role. During the 1980s, Germany performed this task by supplying the credibility of its anti-inflationary monetary policy as the public good. In the 1990s, however, the general macroeconomic picture has changed, the high inflation rates of many European countries have disappeared, and the public good provided by the Bundesbank has diminished in value.

The above sections have analysed the costs and benefits of a system with "almost" completely fixed exchange rates. The benefits are mainly the possibility of anchoring monetary policy to German monetary policy; the costs derive from the loss of exchange rate flexibility and of autonomous monetary policy. There is an obvious contradiction here. For the benefits to emerge there must be credible commitment to exchange rate stability, which means that there is a credible renunciation of exchange rate variation. The rigidity of the exchange rate necessary to create this credibility, however, raises the costs of belonging to the system. Both costs and benefits tend to increase with an increase in the degree of rigidity of the exchange rate.

This does not apply to all countries in the same way, however. In some countries, the loss of monetary autonomy is not a high cost, both because they have economic policy objectives very similar to Germany's and because they have economies very open to Germany's, so that a variation in the nominal exchange rate has entirely temporary effects.

Taking the case of Italy, it is possible to draw interesting comparisons between *two Italys*. The *first Italy*, that of the early 1980s, is characterised by robust inflation - inflation kept high, amongst other things, by strong inflationary expectations - by a high level of real wage indexation, and by a somewhat low stock of public debt. The first of these features indicates that the advantages to be gained from anchoring Italian monetary policy to German policy are high in terms of the stabilisation of inflationary expectations. The second feature indicates that the possible advantages deriving from varying the exchange rate, in terms of altering the relative prices of domestically produced goods, are extremely short-lived - given that the wage increases induced by index-linking push up domestic production costs. Finally, the third feature enables flexible use to be made of

the interest rate to stabilise the exchange rate, particularly during periods of tension on the foreign currency markets.

The *other Italy*, that of the 1990s, is characterised by a slight inflationary differential which has persisted despite a credible exchange rate arrangement - a differential apparently caused by, so to speak, *structural* factors -, by a very low degree of real wage indexation, by increasingly weak and less combative trade unions, and by an enormous stock of public debt, consisting mostly of short-term securities. In this case, whereas the advantages of an exchange rate arrangement appear to be modest, and may even turn into costs when the persistent differential undermines the competitiveness of Italian exports, the exchange rate instrument appears to be highly effective, given the rigidity of nominal wages. The high stock of public debt, moreover, renders the use of the interest rate to stabilise the exchange rate in moments of crisis rather inflexible and/or very costly.

Whereas for the *first Italy* the advantages of the exchange rate system are presumably greater than the costs, for the second Italy the order of preferences is reversed: the loss of monetary independence, especially in the presence of a highly restrictive policy by the leader country, seems to be anything but off-set by the modest advantage of greater credibility.

4.5 The Future of the EMS

The new EMS failed to overcome the second important crisis occurred in the summer of 1993: the width of the bands of oscillation dramatically increased going from ±2.25% to ±15%. It is self-evident that with the new bands width what remains of the EMS can hardly defined as a fixed exchange rates system. There are different economic explanations for this, each of them containing a grain of truth; yet the most important reasons seems the power of speculation in the international foreign exchange market.

The technical reason for the strength of speculative attacks rests on the lack of any form of capital controls, which makes the scale of official reserves ridiculously small in comparison with the huge amount of capital available for speculative movements. In this framework, the interest rate instrument appears much more effective against speculative attacks. Raising the interest rate, however, is not a costless policy, given its effect on the production level, on public finance and on the stability of the financial structure. It is not by chance that the first two countries which were forced to leave the system were the ones which because of its the high level of the outstanding public debt,

Italy, and because its role in the international capital markets, Great Britain, were particularly reluctant to use the interest rate instrument.

The reasons prompting the speculative attacks are various and they play different roles in the different countries involved in the crisis. The first reason is that a realignment was delayed because of the misguided belief that a *hard EMS* had achieved enough credibility to sustain existing parities until full convergence had occurred. Therefore some countries, manly Italy, had accumulated inflation differential and their currencies had become overvalued. Most countries were then hit by the asymmetric shock of German monetary and political union. A response to this disturbance should have been a real appreciation of the Deutschmark (a fall in prices and costs in other EMS countries relative to those prevailing in Germany). Some EMS countries, and mainly France, denied Germany the option of revaluing its currency and therefore rendered necessary either a burst of inflation in Germany and stable prices elsewhere, or a stable price in Germany and a burst of deflation elsewhere. A third and simpler option was to devalue the other European countries' currencies. According to this interpretation, the crisis was a way of forcing reluctant governments to accept the exchange rate correction, The third explanation of the crisis hinges on public opposition to the Maastricht Treaty which was fuelled by the worsening of general economic conditions. In this view, the markets simply anticipated the abandonment of the too tight policies required by the Maastricht Treaty. Lastly, the Maastricht Treaty in itself could have had a destabilizing role, as was already been discussed before.

Concluding, brief examination of the implications of the analysis for the future of the EMS may be of interest. There are two ways forward, if one excludes the possibility of rapid achievement of monetary union.

In the first scenario, the system tries to survive with the existing large band of oscillations as it waits for better times [22]. Larger oscillation bands discourage, at least partially, speculative attacks, as the experience of the EMS has amply shown [23]. In

[22] A problem of legal interpretation of the Maastricht Treaty is important at this stage: do the new oscillation bands satisfy the cited exchange rate criterion of the Maastracth Treaty ? In other words could they be interpreted as *normal* oscillation bands?

[23] Suffice to notice what happened in the first years of the EMS: the Franch franc which fluctuated in a narrow band was under the attacks of speculation much more than the Italian lira which enjoyed a larger band. Were the central parity to be change and the band large enough, the change can take place withoud discrete jumps in the value of the excahnge rate which represent the best source of the profit for speculators.

addition they ensure a certain degree of monetary policy autonomy, at least in the short period [24] . The main criticism of this option regards the difficulty of ensuring the European single market when the nominal exchange rate can vary around the 30% without any intervention by Central Banks. Moreover, they exacerbate credibility problems. In a period of international recession a strong incentive to run a beggar thy neighbour policy may emerge via competitive devaluations.

The view that the excessive variability of exchange rates can jeopardise the economic union and the single market has prompted some authors to suggest a rapid return to narrower bands. The turbulence in the foreign exchange market, however, and the strength of speculation in absence of capital controls makes this option hardly sustainable. To overcome this obstacle and to provide the monetary authority with a minimum of autonomy in conducting monetary policy, some authors (Eichengreen and Wyplosz, 1992) have re-proposed Tobin's idea of putting "sand" in the wheels of the foreign exchange markets. What they suggest is not a revival of administrative control - no longer possible under the provision of the Maastricht Treaty and the Single European Act - but rather an explicit or implicit tax - via non-interest-bearing deposit requirements - on foreign exchange transactions. Both measures work by raising the cost of cross-border capital flows and they penalise short-term capital movements more heavily than longer-term investments. They could support weak currencies in the short-term, and but it would take time to organise orderly realignments in the case of persistent disequilibria without jeopardising the overall stability of the system.

In my opinion, however, both proposals miss the main point which needs to be clarified if the project of the European monetary union is to be revitalised: the problem of conduct of the monetary policy within the area. This ambiguity remain unresolved because both options leave some autonomy to the national monetary authorities. This prooblem was implicitly solved during the years of the *new EMS* through the asymmetric nature of the system, where the Bundesbank set the monetary policy for the entire area and other countries defended the parities of their exchange rate. Interpretations of the EMS as a disciplinary device provide the theoretical anchor for this political choice.

The analysis proposed in the previous sections shows that the asymmetric management of economic policy is justified neither on theoretical grounds nor on

[24] The recent paper of Svensson (1992) provides a therotical support to this argument.

empirical ones. Moreover, the asymmetric management of the monetary policy seems to be one of the main reason for the development of the crisis.

This leads to the conclusion that the EMS structural crisis can be solved only by an institutional innovation process which leads to the creation of a European Central Bank which assumes control of monetary policy in the entire area. The cooperative management of monetary policy for the whole of the European Community, entrusted to a European Central Bank, would increase the advantages of participating in the agreement, in terms of increased efficiency in the absorption of exogenous shocks to the European economy, and could ensure greater stability for the system. The same outcome, however, could also be obtained, while maintaining the present structure, if the leader country, Germany, took it upon itself to conduct a monetary policy able to minimise tensions within the currency area. This would probably incur a cost for German compared with the present situation. The threat of a return to decentralised policies which would induce the breakdown of the exchange rate agreement might provide the necessary incentive for Germany to cooperate.

5. Coalition and cooperation in a three country model

In this chapter I analyse the case of a three country world. This analysis appears interesting for several reasons. First of all, it is important to see how the central issue of the benefit from cooperation is affected by increasing the number of players involved in the game. Secondly, we can use this framework to investigate different equilibrium solutions, such as different types of partial cooperation between a subset of players. Lastly, we can use this framework to address questions such as coordination on the rules of the games: in other words we may address questions regarding the role played by exchange rate arrangements.

Figure 5.1.1.

1) $y_{IT} = -\gamma_1 r_{IT} + \delta_1 c_1 + \delta_2 c_2 + \eta_1 y_G + \eta_2 y_{US}$
2) $i_{IT} = \varphi_1 y_{IT} + \sigma_1 \dot{c}_1 + \sigma_2 \dot{c}_2 + \pi_{IT}$
3) $\pi_{IT} = \xi\varphi_1 z_{IT} + \xi\sigma_1 c_1 + \xi\sigma_2 c_2$
4) $\dot{z}_{IT} = y_{IT}$
1′) $y_G = -\gamma_2 r_G - \delta_3 c_1 + \delta_4 c_2 + \eta_3 y_{IT} + \eta_4 y_{US}$
2′) $i_G = \varphi_2 y_G - \sigma_3 \dot{c}_1 + \sigma_4 \dot{c}_3 + \pi_G$
3′) $\pi_G = \xi\varphi_2 z_G - \xi\sigma_3 c_4 + \xi\sigma_4 c_3$
4′) $\dot{z}_G = y_G$
1″) $y_{US} = -\gamma_3 r_{US} - \delta_5 c_2 + \delta_6 c_3 + \eta_5 y_{IT} + \eta_6 y_G$
2″) $i_{US} = \varphi_3 y_{US} - \sigma_5 \dot{c}_2 - \sigma_6 \dot{c}_3 + \pi_{US}$
3″) $\pi_{US} = \xi\varphi_1 z_{US} - \xi\sigma_5 c_2 - \xi\sigma_6 c_3$
4″) $\dot{z}_{US} = y_{US}$
5) $E(\dot{c}_1) = r_{IT} - r_G$
6) $E(\dot{c}_2) = r_{IT} - r_{US}$
7) $E(\dot{c}_3) = r_G - r_{US}$

The basic features of the model are the same as those of the model presented in the chapter 2, once the third country is accounted for. In what follows, it is assumed that in the world there are two European countries (say Italy and Germany) and an extra-European country (say United Sates). Therefore the model proposed in chapter 2 has been modified in the manner shown in figure 5.1.1. I relax the hypothesis of perfect symmetry employed in previous chapters by assuming that the two European countries are more

integrated with each other, ($\eta_1 = \eta_3 > \eta_2 = \eta_4 = \eta_5 = \eta_6$, $\delta_1 = \delta_3 > \delta_2 = \delta_4 = \delta_5 = \delta_6$ and $\sigma_1 = \sigma_3 > \sigma_2 = \sigma_4 = \sigma_5 = \sigma_6$ [58]) than they are with to the United States.

We have now three different exchange rates. Only two of them are independent; we can write, in fact, $\dot{c}_3 = \dot{c}_2 - \dot{c}_1$. Therefore the equations regarding Germany and the United States can be rewritten by eliminating one of the exchange rates. This gives rise to the model presented in figure 5.1.2.

Figure 5.1.2.

$$1') \; y_G = -\gamma_2 r_G - (\delta_3 + \delta_4)c_1 + \delta_4 c_2 + \eta_3 y_{IT} + \eta_4 y_{US}$$
$$2') \; i_G = \varphi_2 y_G - (\sigma_3 + \sigma_4)\dot{c}_1 + \sigma_4 \dot{c}_2 + \pi_G$$
$$3') \; \pi_G = \xi\varphi_2 z_G - \xi(\sigma_3 + \sigma_4)c_1 + \xi\sigma_4 c_2$$
$$4') \; \dot{z}_G = y_G$$
$$1'') \; y_{US} = -\gamma_3 r_{US} + \delta_6 c_1 - (\delta_5 + \delta_6)c_2 + \eta_5 y_{IT} + \eta_6 y_G$$
$$2'') \; i_{US} = \varphi_3 y_{US} + \sigma_6 \dot{c}_2 - (\sigma_5 + \sigma_6)\dot{c}_3 + \pi_{US}$$
$$3'') \; \pi_{US} = \xi\varphi_1 z_{US} + \xi\sigma_6 c_2 - \xi(\sigma_5 + \sigma_6)c_2$$
$$4'') \; \dot{z}_{US} = y_{US}$$

As in the previous chapter I shall assume that the three countries' policy makers care about both real income and for core inflation, displaying the following welfare functions:

$$W_{IT} = \int_t^{\infty}\left[\beta_{IT}\pi_{IT}^2 + y_{IT}^2\right], \; W_G = \int_t^{\infty}\left[\beta_G\pi_G^2 + y_G^2\right], \; W_{US} = \int_t^{\infty}\left[\beta_{US}\pi_{US}^2 + y_{US}^2\right]$$

In what follows I restrict the analysis to time consistent solutions. The case of the full optimal but time inconsistent solution, although important from other points of view, is of no interest as regards the question of the benefit from cooperation is concerned. It has been already stressed that the perverse result of the counter-productivity of cooperation emerges when the advantages from cooperation represented by the internalisation of externality effects are overcompensated by the disadvantages represented by the worsening of the credibility bias.

The way in which we compute the time consistent solution has been clarified in previous chapters. I briefly recall that the core of the solution is to impose a new constraint on the policy-maker's optimisation problem - the non-predetermined variables must follow a path obtained as a linear combination of the state variables. In the

[58] Specifically we set $\eta_1 = \eta_3 = 1/3$, $\eta_2 = \eta_4 = \eta_5 = \eta_6 = 1/4$, $\delta_1 = \delta_3 = 1/2$, $\delta_2 = \delta_4 = \delta_5 = \delta_6 = 0.45$,$\sigma_1 = \sigma_3$ 1/10 and $\sigma_2 = \sigma_4 = \sigma_5 = \sigma_6 = 0.085$

framework presented in figure 5.1.2. We have three state variables and two non predetermined variables: therefore the time consistent constraints would be:

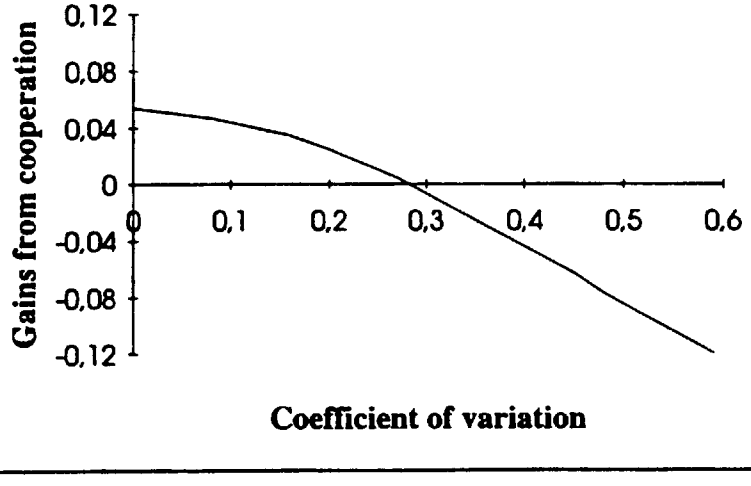
$$[c_1 \quad c_2] = \begin{bmatrix} \theta_{11} & \theta_{12} & \theta_{13} \\ \theta_{21} & \theta_{22} & \theta_{23} \end{bmatrix} \begin{bmatrix} z_{IT} \\ z_G \\ z_{US} \end{bmatrix}$$

As before, the values of θs are obtained iteratively and are the result of the interplay between the activities of economic agents in forecasting the value of the non-predetermined variables, accounting for the incentive of the policy-maker to renege and the activity of policy-makers in maximising welfare taking this private behaviour into account.

5.1 Benefit from cooperation in a three country world

There are no reasons, on a priori grounds, to expect that the welfare ranking of cooperation and Nash behaviour would be reversed with respect to that obtained in the two country case. On the contrary, we would except the negative gains from cooperation to increase in a three country framework, for two reasons: on the one hand, it has been argued that the size of the policy externalities tends to decrease with an increase in the number of interdependent countries, on the other hand, the credibility bias may increase, since there are now two exchange rates and therefore two forward-looking variables.

Figure 5.1.3



The results of the simulations confirm this first intuition: as far as the time consistent solution is concerned, the question of benefit from cooperation is still closely

tied to the dimension and the distribution of initial shocks; as a measure of the former I will use the global average of initial inflation rates, and as measure of the latter their standard deviation: both are shown in table 5.1.1a. one notes immediately that cooperation is more likely to be productive, the higher the average shock and the lower the standard deviation of initial inflation rates. Moreover, table 5.1.1b shows the distribution of welfare losses among countries. Figure 5.1.3 plots the gains from cooperation against the coefficient of variation (standard deviation divided by the average): it is evident that gains from cooperation depend on the value of the coefficient of variation [59].

Table 5.1.1a

Initial shocks z_{IT}	z_G	z_{US}	Average shock	Standard deviation of shocks	Loss from Nash	Loss from Coop	Gains from Coop
9	0	0	3	4.2	3.958	3.974	-0.40%
7	1	1	3	2.8	2.594	2.601	-0.25%
5	3	1	3	1.8	1.868	1.870	-0.07%
4	3	2	3	0.82	1.594	1.593	0.03%
3	3	3	3	0	1.501	1.500	0.06%

Table 5.1.1b

Initial shocks			Loss from closed loop Nash			Loss from Coop		
Z_{IT}	Z_G	Z_{US}	Italy	Germany	US	Italy	Germany	US
9	0	0	11.832	0.022	0.018	11.837	0.027	0.023
7	1	1	7.303	0.246	0.236	7.321	0.247	0.237
5	3	1	3.861	1.509	0.236	3.865	1.508	0.237
4	3	2	2.548	1.508	0.725	2.549	1.507	0.724
3	3	3	1.507	1.507	1.488	1.506	1.506	1.486

Furthermore, there exists a value of the coefficient such as to switch the welfare ranking between productivity and counterproductvity of cooperation. With the value of parameters considered here, we find that the critical value of the coefficient of variation is about 0.29. This means that, in order for the cooperative solution to be attractive, the average shock must be at least three and a half times greater than the standard deviation of initial inflation shocks. Note how this critical value changes when some of the parameters of the model are altered. It can be easily shown that it increases when the value of δ increases and decreases when σ increases. While δ - that is, the effect on output on a change in the exchange rate - measures the advantage in terms of output of a depreciation, or the costs of an appreciation, σ measures the effects of a change in the

[59] In this case I have assumed that our three countries are perfectly symmetric in order to prevent the allocation of shocks among countries from affecting the welfare results.

exchange rate on core inflation - the price effect of a depreciation. Moreover, both represent an indirect measure of the external effects. The higher δ is and the lower σ is the less effective a decentralised policy becomes and the greater the inefficiency of Nash policies. Therefore the cooperative solution gains in appeal.

In order to simplify the comparison with the Miller and Salmon two country model, I begin with the case in which the initial shock is represented by an inflation upsurge in Italy ($z_{IT}(0)=10$), while in Germany and US inflation remains at zero.

Table 5.1.2 shows the main findings. As was to be expected, the Nash closed loop solution provides a welfare outcome superior to the cooperative solution. As in the two country case the time consistent constraint calls for a less rapid Italian monetary contraction, while Germany and Unites States implement a more rapid policy response. It brings about a more rapid response in the case of symmetric shocks but a slower response in the case of asymmetric shocks. Since in this case the inflation shock impinges solely on Italian economy, the cooperative solution is sub-optimal.

Table 5.1.2

			Closed-loop Nash			Co-operative			European Co-operative		
Roots			-0.961	-0.869	-0.867	-1.000	-0.824	-0.823	-0.978	-0.872	-0.822
Riccati coefficients:											
θ_{11}	θ_{12}	θ_{13}	-0.649	0.649	0	-0.623	0.623	0	-0.622	0.622	0
θ_{21}	θ_{22}	θ_{23}	-0.666	-0.017	0.730	-0.639	-0.017	0.706	-0.659	-0.036	0.729
Reaction coefficients:											
ρ_{11}	ρ_{12}	ρ_{13}	0.649	0.086	0.105	0.627	0.115	0.131	0.634	0.122	0.106
ρ_{21}	ρ_{22}	ρ_{23}	0.086	0.649	0.105	0.115	0.627	0.715	0.122	0.634	0.106
ρ_{31}	ρ_{32}	ρ_{33}	0.071	0.071	0.737	0.102	0.102	0.714	0.068	0.068	0.736
Initial values:											
z_{IT}	z_G	z_{US}	10	0	0	10	0	0	10	0	0
y_{IT}	y_G	y_{US}	-9.004	-0.321	-0.292	-8.832	-0.607	-0.579	-8.887	-0.661	-0.293
π_{IT}	π_G	π_{US}	8.785	0.634	0.581	8.834	0.608	0.557	8.817	0.591	0.591
r_{IT}	r_G	r_{US}	6.498	0.864	0.707	6.273	1.151	1.027	6.348	1.227	0.681
	c_1			-6.488			-6.225			-6.225	
	c_2			-6.662			-6.390			-6.590	
	c_3			-0.174			-0.165			-0.365	
Welfare loss:											
W_{IT}	W_G	W_{US}	14.61	0.027	0.0231				14.68		0.0235
Average				4.887			4.907			4.901	
Gains from coordination							-0.04%			-0.02%	

5.1.1 The case for coalitions: European coordination

As has already been pointed out, one of the advantage of using a three country model is that enables the analysis of the case in which only two countries are involved in

cooperation. In other words, I can assume that two countries form a coalition against the third one. Since we have assumed that there are two European countries and an extra-European country in our framework, we can interpret the case in which the two most integrated countries cooperate which is the case of monetary cooperation among European countries [60].

In this section, therefore, I assume that together with the already described Nash and cooperative policies we also have a case, which I call European cooperation, in which there is cooperation within Europe and competition between Europe and the rest of the world. The coalition is attractive because it allows the internalisation of the externalities that European countries impose on each other. This entails the assumption that there is a common monetary authority in Europe, something like the European Central Bank, which sets monetary policy so as to maximise the weighted average of the two welfare functions:

$$W_E=aW_\Pi+(1-a)W_G$$

On the other hand, this European institution does not cooperate with the American monetary institution: a Nash closed loop equilibrium will prevail in this case. By considering a cooperative-Nash equilibrium, we allow the US policy maker to react to the European coalition decision.

The first question warranting attention is the existence of a benefit from European cooperation. In other words, the intention is to investigate the conditions under which the formation of a coalition between the Italy and Germany will be beneficial. The question can be evaluated from two different points of view. The first one is global: are there situations in which the formation of such a coalition can improve the world welfare as a whole compared to the case in which each policy maker acts individually as a Nash player? The second point of view restricts the analysis to European countries: in this case, it is of some interest to see whether the formation of a European coalition makes European countries better off than in the Nash case [61].

With regard to the first question, there are situations in which the implementation of European cooperation is the best possible time consistent solution for the entire world. Once again the welfare ranking of the different solution concepts will

[60] We assume that binding agreements are possible.

[61] Note that this solution concept does not need the agreement of all the players. It is in fact sufficient that the two European countries decide to run a joint policy.

depend on the distribution of shocks among countries. In order to analyse this, I assume that the entire world is hit by an world-average inflation shock equal to 3.333.

Table 5.1.3a

Initial shocks z_{IT}	z_G	z_{US}	Average shock	Standard deviation of shocks	European difference	Loss from Nash	Loss from Coop	Loss from Eurocoop
1	1	8	3.333	14	0	**3.3306**	3.3377	3.3307
2	2	6	3.333	8	0	2.3334	2.3346	**2.3333**
5.5	3	1.5	3.333	8	2.5	2.2283	2.2295	**2.2277**
6	2	2	3.333	8	4	**2.3404**	2.3424	2.3416
3	3	4	3.333	2	0	1.8823	**1.8809**	1.8817

Table 5.1.3b

Initial shocks			Loss from Nash			Loss from Coop			Loss from Euro-coop		
z_{IT}	z_G	z_{US}	Italy	Germany	US	Italy	Germany	US	Italy	Germany	US
1	1	8	0.2583	0.2583	9.475	0.260	0.260	9.493	0.2581	0.2581	9.476
2	2	6	0.763	0.763	5.473	0.763	0.763	5.479	0.762	0.762	5.474
5.5	3	1.5	4.678	1.543	0.464	4.683	1.541	0.464	4.679	1.539	0.465
6	2	2	5.508	0.765	0.748	5.516	0.764	0.747	5.513	0.763	0.749
3	3	4	1.541	1.541	2.565	1.534	1.534	2.563	1.538	1.538	2.566

Table 5.1.3a and table 5.1.3b report the welfare yields - in aggregate terms and at national level respectively - when different national distributions of the shock are assumed. When the initial shocks are strongly asymmetrically distributed between Europe and USA - first row of the table - the Nash response is to be preferred. In this case, in fact, the necessary adjustment of the exchange rate is such as to determine an high credibility bias. However, were the initial distribution of shocks to be somewhat less asymmetrical - second row of the table - European cooperation would emerge as the best policy reaction for the entire world. The fact that the initial inflation shock is the same in European economies means that the European exchange rate need not change. Thus the credibility bias do not dramatically emerge, while the externalities within Europe are internalised. However, the distribution of gains from coordination among countries is unfair: Italy and Germany improve their welfare while the United States impairs it. It is important to stress that this does not render European cooperation not achievable because the explicit participation of the United States is not required.

The third and fourth row of the table show, moreover, that in evaluating European cooperation, the infra-European distribution of shocks is important. The initial shocks, however, need not be equal across the European economies to render European

cooperation profitable for the entire world (third row) [62]. When the initial shocks of Italy and Germany are markedly different, in fact, their exchange rate needs to be adjusted; then the credibility bias would emerges. Finally, when the degree of symmetry is sufficiently high, as in the last row of the table, full cooperation is to be preferred since it is able to capture the entire benefit of the internalisation of external effects without paying too much in terms of credibility. In this case, European cooperation is still to be preferred to the Nash policy.

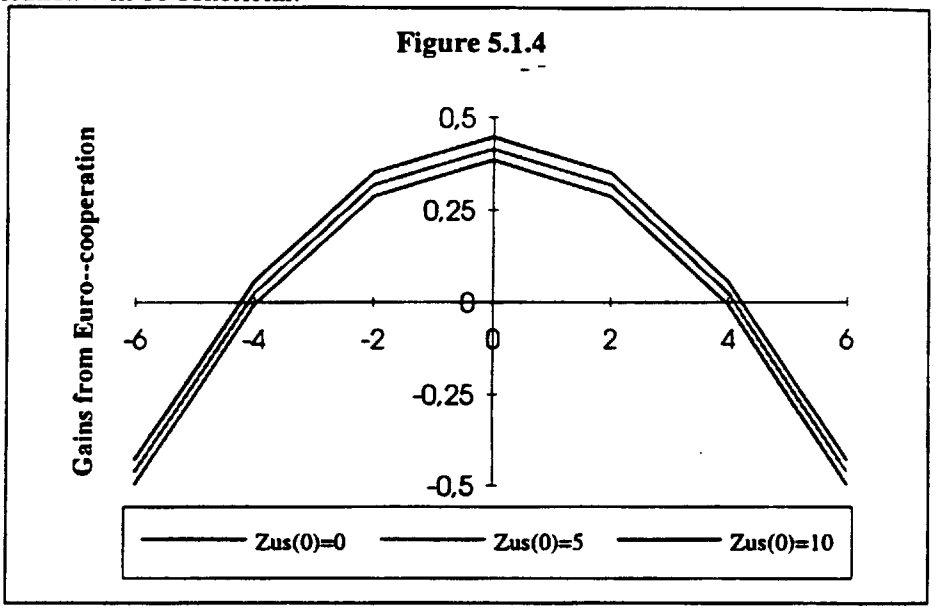
The reason for the optimality of European cooperation is clearer on inspection of table 5.1.2. The reaction coefficients show that, when an European cooperation is implemented, the two European countries react, on average, more to shocks than in the Nash case, while the reaction of the USA is slightly inferior. Therefore, as long as the distribution of shocks is not too asymmetric, European cooperation ensures a more rapid return to equilibrium. With regard to the full cooperation, it is evident that European countries react less to a USA inflation shock, but they react more as far their own inflation shocks are concerned. The Riccati coefficients show that European cooperation and full cooperation are equally constrained by the time consistency of the policy with respect to the infra-European exchange rate, but much less constrained with respect to the extra-European exchange rate. This explains why, once shocks are significantly symmetric, full cooperation regains its optimality.

An interesting feature of the European cooperation solution is that it does not need the agreement of the three countries to be implemented: it is actually sufficient that Italy and Germany agree to cooperate. Therefore the viability of this coalition should be evaluated by comparing the average welfare of the two European countries: they will decide to cooperate if the welfare costs under European cooperation are less than the welfare costs under decentralised policies. Obviously enough, this case is rather similar to the standard two country model: gains from coordination emerge the higher the average shock and the lower the difference between European countries. Inflation shock hitting the United States can be interpreted as a symmetric shock. Figure 5.1.4 plots the gains from European coordination when distinct European inflation rate differentials are considered: it shows that European coalition will fail, i.e. the gains from European coordination are negative, when European countries are hit by asymmetric shocks, as is

[62] In this case, however, an incentive problem would emerge: cooperation is not desirable from the point of Italian policy maker.

the case in the tails of the curves, and it is beneficial when shocks are more symmetrically distributed between European economies. Moreover the figure shows that the curves shift upward when the inflation shocks of the third country increases. This means that the higher the US inflation shocks, the more likely it is that European cooperation will be beneficial.

Figure 5.1.4



In conclusion to this section I compare my findings with those of Miller and Salmon (1985 and 1989) and Canzoneri and Henderson (1991). In common with the latter, I have obtained the result that cooperation between two of the three policy makers may be counter-productive. As in Miller and Salmon, although they use a two country model, the crucial role in determining the counter-productivity of cooperation is played by the distribution of initial shocks. However, it is worth pointing out two important and new conclusions to be drawn from the analysis.

First, there are situations in which cooperative behaviour between European countries improves aggregate world welfare. These situations are characterised by the existence of an asymmetrical distribution of shocks among the three countries which renders full cooperation unattractive, and of more symmetrical infra-European distribution of shocks. It cannot be denied that this appears to be the most relevant case from an empirical point of view. European economies more closely resemble each other, as far as economic structure and institutional environment is concerned, than they do the United States.

Secondly, the European coalition is more likely to be beneficial if a marked disturbance originates from outside Europe. This seems to confirm the conventional idea that the highly integrated and fairly similar European economies have a stronger incentive to cooperate between each other when the disturbances deriving from outside are relevant and/or when the economic policy pursued by the rest of the world is markedly different from the European one.

5.2 Policy coordination and exchange rate targeting

It has been generally argued that an agreement for the stabilisation of the exchange rate can be seen as a surrogate for a more explicit form of cooperation. Therefore in this section I shall analyse the case in which an agreement on the stabilisation of the exchange rate is reached between the two European countries. I shall compare this solution both with a situation in which the infra-European exchange rate is free to float and economic policies are pursued in a decentralised way and with a cooperative solution, either with or without an explicit target on the exchange rate.

In order to replicate a situation in which the exchange rate is not completely free to move we will assume that the European welfare function are as follows:

$$W_{IT} = \int_t^{\infty} \left[\beta_{IT}\pi_{IT}^2 + y_{IT}^2 + \beta_{IT}^e e^2\right], \quad W_G = \int_t^{\infty} \left[\beta_G \pi_G^2 + y_G^2 + \beta_G^e e^2\right]$$

European policies are constrained by the weight given to the stabilisation of the nominal exchange rate: it goes without saying that the exchange rate agreement need not to work symmetrically, since we can identify a situation in which:

$$\beta^e_G = 0 \text{ and } \beta^e_{IT} \neq 0.$$

In this case, the burden of stabilising of the exchange rate falls exclusively on the Italian monetary authority. The weight given to the exchange rate target represents the degree of commitment to exchange rate management. Note that if we assume that $\beta^e = \infty$, this signifies that the exchange rate is completely fixed. In what follows I assign to β^e a high although finite value in order to preserve the dynamics of the model. In other words, we may say that the weight assigned to the exchange rate target gives us an inverse measure of the width of the target zone.

Since the intention is to depict a close as similar as possible to events in Europe during the eighties, I shall assume that the German Monetary Authority shows a higher attitude against inflation and less inherited inflation than its Italian counterpart. In fact, I shall simulate a situation in which the major inflation shock comes from the United

States: Zit(0)=2, Zg(0)=1 and Zus(0)=5 and in which β_G=2 and β_{IT}=β_{US}=1. Tables 5.2.1 and 5.2.2. summarise the welfare results.

Table 5.2.1.

	Flexible exchange rate			
	output costs	inflation costs	exchange rate costs	total costs
Italy				
Nash	0.3321	0.3851	0.0965	0.7173
Coop	0.3570	0.3593	0.0978	0.7164
Eurcop	0.3371	0.3803	0.0997	0.7173
Germany				
Nash	0.1413	0.0968	0.0965	0.3351
Coop	0.1629	0.0858	0.0978	0.3346
Euro-coop	0.1484	0.0928	0.0997	0.3340
United States				
Nash	1.8982	1.8893	0.0965	3.7875
Coop	1.9008	1.8897	0.0978	3.7906
Euro-coop	1.8979	1.8899	0.0997	3.7879
Average costs		Nash	Coop	Euro-coop
World average costs		1.6133	1.6139	1.6131
European average costs		0.5262	0.5255	0.5256

Table 5.2.2

	Managed float			
	output costs	inflation costs	exchange rate costs	total costs*
Italy				
Nash	0.5714	0.2223	0.0129	0.7937
Simmetric Nash	0.4792	0.2664	0.0082	0.7456
Coop	0.5496	0.2309	0.0023	0.7822
Eurcop	0.5223	0.2458	0.0023	0.7681
Germany				
Nash	0.1398	0.1015	0.0129	0.3430
Symmetric Nash	0.0875	0.1462	0.0082	0.3801
Coop	0.0850	0.1437	0.0023	0.3792
Euro-coop	0.0837	0.1548	0.0023	0.3934
United States				
Nash	1.8937	1.8976		3.7913
Symmetric Nash	1.8977	1.8921		3.7900
Coop	1.9027	1.8903		3.8009
Euro-coop	1.8977	1.8930		3.7907
World average costs	Nash	Symmetric Nash	Coop	Euro-coop
with ex. rate	1.6859	1.6934	1.6593	1.6586
without ex.rate	1.6429	1.6388	1.6543	1.6588
Europ. aver. costs	0.5683	0.5628	0.5807	0.5807

*This computation does not consider the cost of exchange rate

As noted in the previous section, this scenario suggests that European cooperation is the best aggregate response to the initial shocks; see last row of table 5.2.1. I wish to verify whether agreement on the exchange rate arrangement between European countries can be a surrogate for a more explicit form of cooperation. I distinguish two different kinds of Nash equilibrium: in the asymmetric case I assume that the exchange rate agreement works asymmetrically, since the Italian monetary entirely authority bears the entire burden of controlling the exchange rate - we assume $\beta^e_{IT}=10$ - while the German monetary authority is free to set the monetary policy neglecting the effect on the exchange rate ($\beta^e_G=0$); instead, in the symmetric case I assume that both countries equally share the burden of controlling the exchange rate ($\beta^e_{IT}=\beta^e_G=10$).

Obviously, the deviation of the intra-European nominal exchange rate from the target value is strongly reduced in the case in which the nominal exchange rate is taken as one of policy targets. Figure 5.2.1 compares the path of the nominal exchange rate under managed exchange rate, symmetric and asymmetric Nash and cooperative solutions, and free float. Interestingly this effect is far more important when a cooperative solution is implemented. This is due to the fact that when a cooperative policy is run, the nominal exchange rate becomes a common target. A powerful effect on the exchange rate path is obtained when a symmetric Nash equilibrium is considered as well.

On the other hand, figure 5.2.2 shows that the stabilisation of the infra-European exchange rate is obtained at the expense of increased variability in the extra-European nominal exchange rate. This a result shared with many if not all the theoretical models of exchange rate determination which predict that the volatility reduced with the help of a managed exchange rate system is simply transferred to other economic loci. [63]

Many of the effects of introducing the nominal exchange rate in the welfare function are well known and already described by the literature on the EMS: by managing the exchange rate, the Italian monetary authority acquires some of the antinflationary attitude of the German authority, although at the expense of higher output cost, while the German policy maker is forced to accept higher inflation costs. Figure 5.2.3. shows the path of core inflations under free float and managed exchange rate

[63] A recent empirical study suggests on the contrary that exchange rate volatility is not in fact transferred to some other part of the economy and simply seems to vanish (Flood and Rose, 1993). This supports the view that current models of exchange rate behaviour are far from being satisfactory.

solutions. As predicted by the literature on credibility, unilateral asymmetric pegging is the scenario that allows a more marked reduction of core inflation.

Evidently if we assume that the exchange rate is just an intermediate target and therefore neglect it in computing the welfare losses, the symmetric Nash solution emerges as the preferable solution concept in this scenario, as regards world welfare and European welfare.

Two important results deserve particular mention. First, the comparison between symmetric and asymmetric exchange rate agreements under Nash solution shows that the lack of symmetry brings about higher costs. This is straightforward in the case in which the loss involved in the deviation of the nominal exchange rate from its equilibrium value is considered, since the stabilisation of the exchange rate is far more efficacious when controlled by both countries. Moreover, even if we consider the exchange rate as an intermediate target and do not consider it explicit in the welfare calculation, we still have the superiority of the symmetric decentralised policies. The choice between symmetric and asymmetric intervention in the foreign exchange market, however, is not neutral with respect to the distribution of the cost between Italy and Germany. Obviously enough, in the case of symmetric intervention rule, the share of adjustment beard by Germany is larger than in the case in which the asymmetric exchange rate arrangement is implemented. Nevertheless, it is interesting to note that while the literature on the EMS has accustomed us to view asymmetry as a positive value, our analysis points to the opposite conclusion, in that it shows that relinquishing symmetry reduces the effectiveness of monetary policies and brings about higher aggregate costs [64].

Moreover, the mild form of cooperation represented by the cooperation on the rules of the game can be seen as a very imperfect surrogate for explicit cooperation between European countries. It leads to a higher welfare costs both for Italy and Germany, also in the case in which exchange rate is just an intermediate target. The reason is simple: the objective of limiting the range of the nominal exchange rate calls for a less active use of the policy instrument, thereby increasing the adjustment costs. Figure 5.2.4 shows the path of Italian interest rate under free float and managed exchange rate solutions.

[64] It cannot denied, however, that the comparison is not completely correct, since in our scenario, also the German monetary authority lacks credibility but is less prone to inflation preferences.

5.2.1 Optimal Exchange rate targeting

While the previous section replicate a situation in which there was a strong commitment to an exchange rate stabilisation, in this section I try to answer the following question: how vigourously should countries pursue the exchange rate target? Is it possible to identify an optimal degree of exchange rate stabilisation, that is, an optimal weight assigned to exchange rate stabilisation in the welfare function of the participating countries? This question has its mirror image in the question of the widths of the target zones for exchange rates. The greater the weight assigned to exchange rate in the policy maker's objective function, the narrower will be the implied target zone. In addition, it is of some interest to see how this optimal targeting will change when the initial conditions and the degree of asymmetry present in the model are altered.

Table 5.2.3

Initial shocks			Weights on inflation			Weight on exc. rate	Italian output cost	Italian inflation cost	Italian total costs
Zit	Zg	Zus	βit	βg	βus				
3	1	2	1	2	1	0.0	0.74761	0.86457	1.41129
3	1	2	1	2	1	0.3	0.75116	0.65632	1.40748
3	1	2	1	3	1	0.0	0.69753	0.71447	1.41201
3	1	2	1	3	1	0.4	0.63277	0.63278	1.40920
6	1	2	1	2	1	0.0	6.14415	5.97529	12.1194
6	1	2	1	2	1	0.2	6.52852	5.56049	12.0890

The case I consider is that of an unilateral targeting. In this case there is no need for an explicit exchange rate arrangement between the two European countries; it is sufficient for one of the two countries to assign a positive weight to exchange rate stabilisation in its objective function. Let us assume that the Italian authority is willing to do so. Table 5.2.3 shows the optimal degree of pegging, in terms of Italian aggregate welfare losses under different frameworks [65]. The first thing to note is that the optimal weight on the nominal exchange rate is not too high with respect to the weights on the other targets [66]. As is evident from the table, the effect of the pegging is to reduce inflation costs at the expense of the output cost: nonetheless, it is convenient in terms of aggregate welfare. The outcome is analogous to that created by a change in policy preference which assigns a greater weight to the antinflationary policy: the main

[65] I maintain that German authority displays greater aversion to inflation than the Italian and American ones, $\beta_G=2$ and $\beta_{IT}=\beta_{US}=1$.

[66] This is true, obviously, when one assumes that median voter preferences are equal to that of the policy maker.

difference is that the change in policy preference is obtained implicitly by assuming the exchange rate as an intermediate target. This appears to be a more viable solution whenever the policy maker does not posses sufficient policy strength to impose the change in policy preferences.

From another point of view, it is evident that optimal exchange rate targeting can be seen as one of the possible manners to solve, at least partially, the inflationary bias induced by the lack of credibility of the policy maker. It works by increasing the indirect costs of reneging. It is interesting, therefore, to compare the outcome provided by pegging with the outcome of the optimal time inconsistent policy and with the outcome provided by the other solutions proposed to reduce the time inconsistency bias. Table 5.2.4. compares the welfare costs determined by the exchange rate targeting with the time inconsistent full optimal policy - obtained assuming the existence of a credible pre-commitment - and the welfare costs in the case a *conservative*, optimally chosen, central banker is appointed. Both solutions allow for a remarkable reduction in the welfare bias determined by the lack of credibility: the external pegging, however, displays the better trade-off between inflation and output costs. Therefore, the exchange rate targeting allows a marked reduction in the inflation bias induced by the lack of credibility. This way of solving the time consistent problem therefore apperas superior to the appointment of a *conservative* central banker.

Finally, we may take a rapid glance at how the optimal degree of exchange rate targeting varies when some of the elements of the framework are changed. Table 5.2.3. presents different occurrences. Looking at rows 2, 3 and 4 of table, one notes that the optimal degree of exchange rate targeting increases with the increase in the difference between the degree of antinflationary attitude of the leading country. In other words, it is convenient to be more closely pegged to a country with a more conservative central banker; or, in other words, the utility of an external constraint is higher when the difference in credibility, proxied by the difference in the value of βs, is high enough. The higher the values of β_G, the stronger the policy reaction of the German monetary authority will be, and more advantages can be obtained by pegging the lira to the DM. This outcome is in accordance with the traditional literature on credibility, and moreover, appears to fit well with the empirical analysis conducted in the previous chapter.

Table 5.2.4

Policy implemented	Italian output cost	Italian inflation cost	Italian total costs
Time consistent policy	0.74761	0.86457	1.41129
Policy with precommitment	0.74480	0.65855	1.40336
Exchange rate targeting	0.75116	0.65632	1.40748
Conservative central banker	0.74615	0.66191	1.40784

Rows 5 and 6 of the cited table confirm an old result of international economics. Pegging our exchange rate is possible if our country and the leader one are not hit by asymmetric shocks. The optimal degree of exchange rate targeting, in fact, will decrease when the difference in the initial inflation levels increases. The higher the initial differences in the inflation rates, the lower the optimal degree of exchange rate targeting will be. This is also confirmed by the analysis we carried in the previous chapter: in the first period of the EMS when the inflation differentials were large, several realignments took place - that is, the *ex post* degree of targeting was low; in the second half of the eighties when the inflation differential were remarkably reduced the *ex post* degree of targeting increases. Finally in the nineties the German monetary and political union shock increases again the with of the exchange rate bands.

Figure 5.2.1.

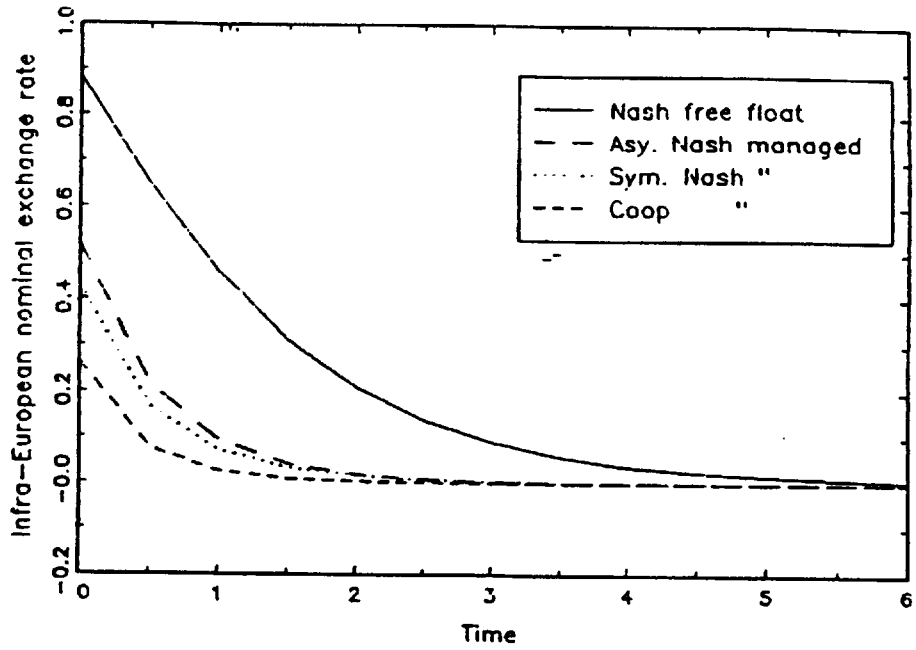


Figure 5.2.2.

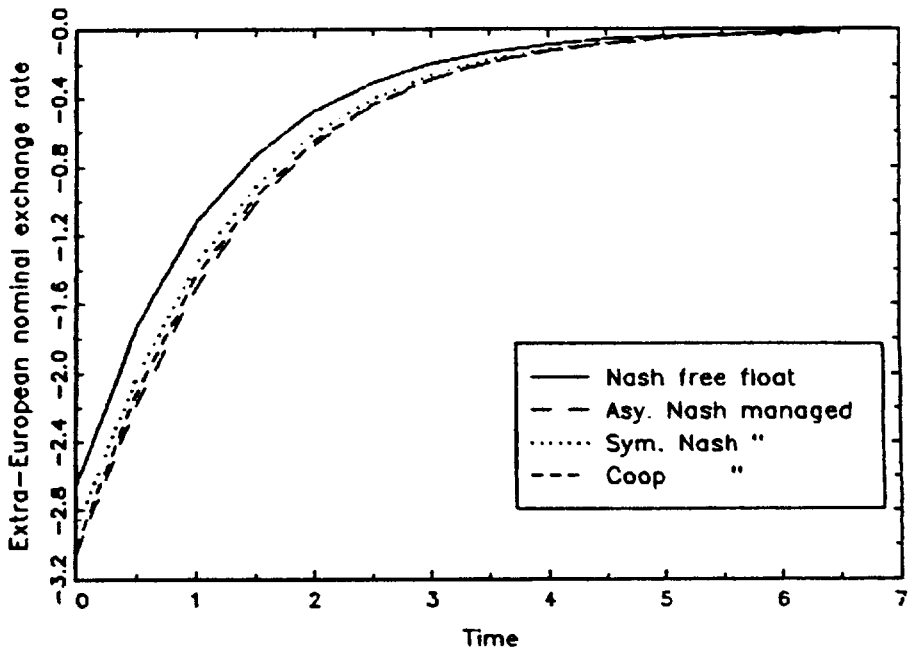


Figure 5.2.3

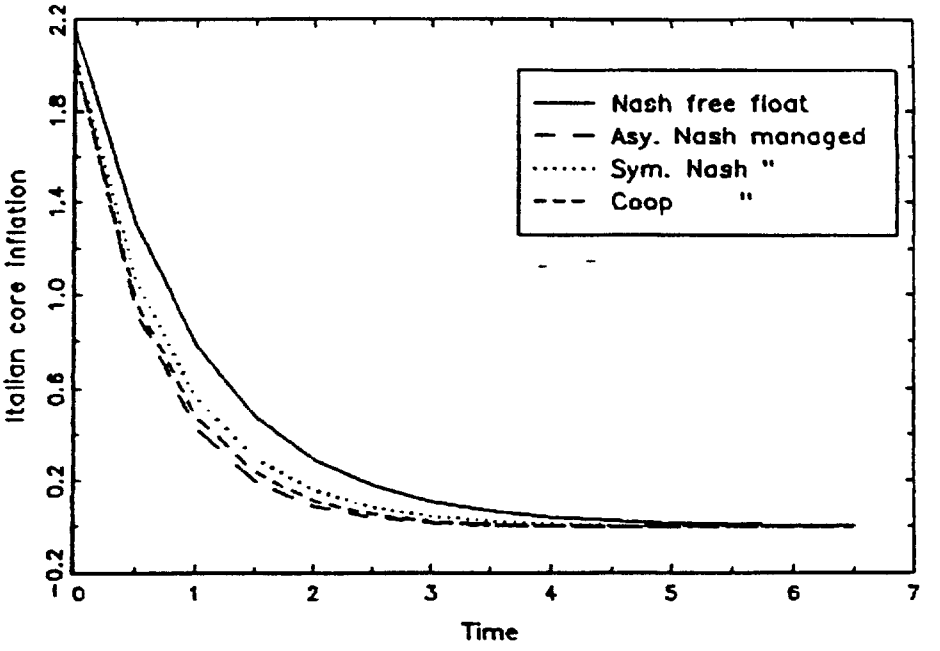
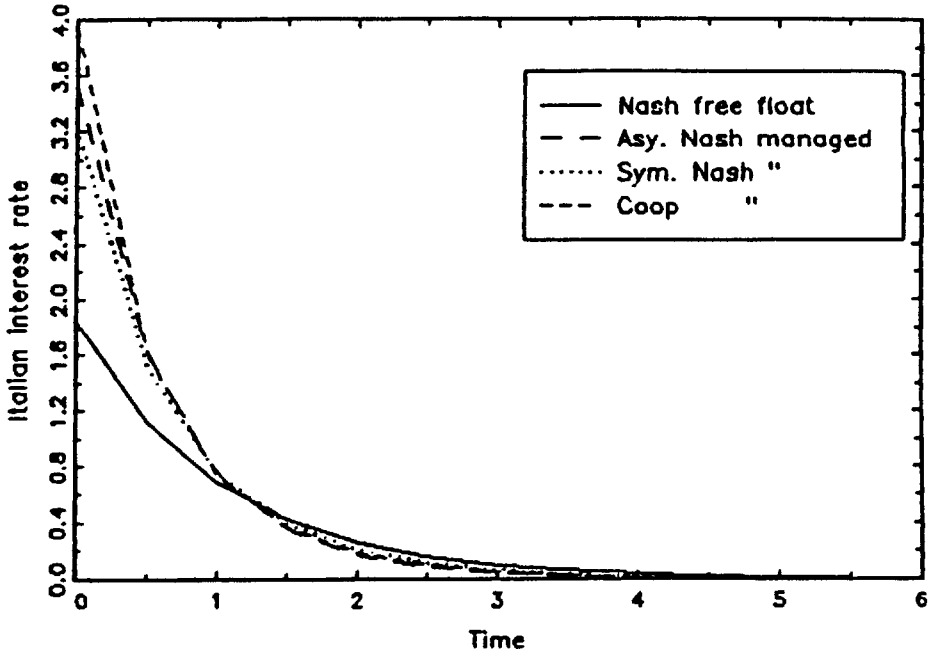


Figure 5.2.4



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